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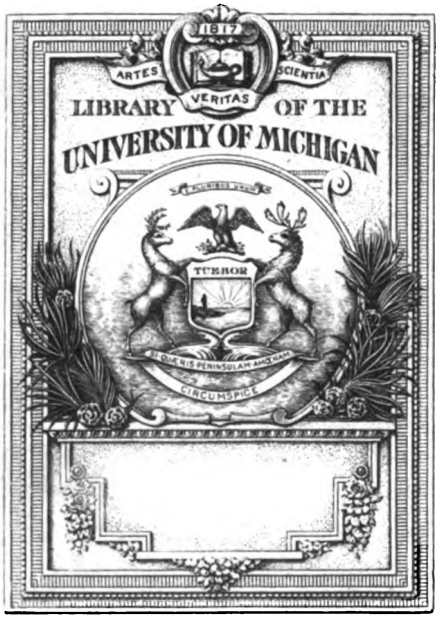

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OKLAHOMA

AGRICULTURAL EXPERIMENT

STATION.

REPORT OF THE DIRECTOR

AND

FINANCIAL STATEMENT,

For Fiscal Year Ending June 30. 1897

STILLWATER, OKLAHOMA.

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OKLAHOMA

AGRICULTURAL EXPERIMENT STATION.

REPORT OF THE DIRECTOR

AND

FINANCIAL STATEMENT.

FOR FISCAL YEAR ENDING JUNE 30, 1897,

STILLWATER, OKLAHOMA.

ANNOUNCEMENT.

The Oklahoma Agricultural Experiment Station is a department of and directly connected with the Oklahoma Agricultural and Mechanical College. A station of similar character is established in each state and territory.

The design, as stated by the act of Congress establishing them, is:

"Acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science."

The proper work is to suggest applications of general principles, rather than to formulate rules of practice either for individuals or for the whole state or territory. The intent of the law is that the work of the Station should be of benefit to the largest possible number, rather than to one or a few individuals. This fact and the limitations of time make it impossible for the Station to undertake extended investigations unless there is good promise that the results may be valuable to many. But it will gladly give any information in its possession on any subject connected with agriculture, in response to request. It will be pleased to receive suggestions as to lines of work thought desirable as aids in deciding on work in the future, and will appreciate information from farmers, fruit-growers, stock-raisers, dairymen, etc., based on their experience or observations. Interested visitors to the Station are always welcome.

The chief work of the Station must be done at the Station. As opportunity offers it will arrange for co-operative experiments with farmers

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where these promise good results. So far as time permits, members of its staff will attend and help the work of agricultural and horticultural meetings.

It will identify specimens of plants or insects believed to be either of probable value or injurious, and give suggestions as to treatment.

It will give counsel and advice in cases of real or supposed outbreaks of disease in farm animals or farm crops.

Its bulletins will be sent, without charge, to any one in the Territory sending name and address.

Address all communications to

AGRICULTURAL EXPERIMENT STATION,
Stillwater, Oklahoma.

REPORT OF THE DIRECTOR.

The Board of Control during the year has been constituted as follows:

*Hon. W. C. Renfrow, Governor, ex-officio, Guthrie.
†Hon C. M. Barnes, Governor, ex-officio, Guthrie.
Hon. John M. DeBois, President, Guthrie.
Hon. F. Caruthers, Treasurer, Oklahoma City.
Hon. R. J. Edwards, Cross.
Hon. W. F. Bort, Kingfisher.
‡Hon. Dale Lytton, Stillwater.

* Until May, 1897. † From May, 1897. ‡ From March, 1897.

The Station Staff during the entire year has been as follows:

George Espy Morrow, M. A., Director and Agriculturist.
Henry E. Glazier, Vice Director and Horticulturist.
George Latimer Holter, B. S., Chemist.
Lowery Laymon Lewis, M. S., D. V. M., Veterinarian.
John Fields, B. S., Assistant Chemist.
John Hayes Bone, B. S., Assistant in Agriculture.
James Tatum DeBois, Clerk.

Each of these has been re-elected for the same position for the ensuing year.

In addition to these one graduate of the College and several of the advanced students have done considerable work as assistants in the conduct of experiments, or in carrying on routine work of a character which would have made it proper to have placed their names on the list.

The work of the year has been somewhat modified by the fact that one member of the staff began his work at its opening; three others only three months before and that, except the chemist, no member had been connected with it for more than one year. Considerable time and thought were necessarily given to reorganization and to planning for systematic work during a series of years.

The Station has continued to occupy rooms in the College main building for its offices and much of the indoor work of the agriculturist, botanist, entomologist, and horticulturist. The small but well equipped chemical

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laboratory has also had to furnish space for the indoor work of the assistant agriculturist and the meteorological observer. An addition to a building on the Station grounds made a fairly convenient laboratory for the veterinarian and a storage room for display of specimens of the Station products: also a small room for dairy work. Much needed additional room for feeding experiments has beeu secured. During the year a definite division of the grounds about the buildings was made between the College and Station. So much of the College farm of 200 acres of fair medium upland prairie soil as is needed for field, orchard, and garden experiments has been used during the year. There is still urgent need of additional room for the convenient doing of many lines of work and the doing of other lines at all satisfactorily. Among the most pressing needs are a green house for the use of the botanical and horticultural departments and additional room for work in the study of the life history of insects. Supplying all these needs from the $750 of the annual appropriation alone available for this use, after repairs, etc., have been paid for from it, is a slow process.

A recognition of this fact and that all the Station funds must be expended in strict compliance with the law will explain why certain lines of work have not been taken up. Thus it has been suggested frequently that the Station could do no more useful work than to expend many thousands of dollars if necessary to determine the practicability of securing water from artesian wells for irrigation purposes. The authorities at Washington have ruled that such expenditures could not possibly be made by the Station; that experiments in irrigation are legitimate but not any considerable expenditure in determining the possibilities of securing water for irrigation plants.

Recognizing the exceptional conditions and the many unsettled problems confronting those interested in any branch of agriculture in a territory so recently settled as was Oklahoma, especial care has been taken to plan the work so as to enable the Station at the earliest possible date to answer a considerable number of these questions, at least in a tentative form. Without losing sight of the fact that a chief duty laid on the Station is to make scientific investigation, unusual efforts have been made to select as subjects those which promised to be of immediate value in their practical applications.

A gratifying evidence of increasing interest in the work of the Station is found in the large and increasing number of inquiries addressed to it for information and the less frequent but welcome letters of information or suggestion.

It is a pleasure to record the helpful suggestions made by Dr. A. C. True, Director of the Office of Experiment Stations, United States Department of Agriculture, during his official visit of inspection of the work of this Station; and also the encouragement given by his commendation of the work and especially the plans for the future.

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In connection with the United States Department of Agriculture, the Station has assisted in some co-operative experiments as the securing of the growth of sugar beets by farmers in different parts of the Territory, samples to be tested to determine their sugar content by the Station chemists; tests of varieties of Egyptian cotton; tests of a large number of native or imported grasses and other forage crops giving promise of suitability to the climatic conditions of Oklahoma; and a comparison of the growth of a number of varieties of forest trees from seed brought from different parts of the United States. Land has been assigned for use in a somewhat extensive forestry experiment under the direction of the Secretary of Agriculture.

Another year of observation leads to an increasingly strong conviction that, at least under conditions existing in Oklahoma, the close relation of the College and Experiment Station found here is decidedly helpful enabling each to obtain a larger number of men specially trained for the difficult and peculiar work at less cost than would be possible under any other arrangement. Each member of the Station staff holds a corresponding position in the faculty of the College. In some cases this double duty has somewhat interfered with what is believed to be an important part of the work of the Station. Aside from its bulletins, the Station can in no way more effectively aid in diffusing information concerning agriculture than by members of its staff attending and giving some of the results of its work at farmer's institutes and the meetings of agricultural, horticultural, and live stock associations. Considerable work of this character has been done during the year and it is hoped to extend it so far as this can be done without injury to the work at the Station.

OUTLINE OF WORK FOR YEAR.

The Agricultural department has made extended studies of soils in the Territory, especially those of the Station farm and vicinity. Their relation to moisture, and the effect of methods of culture and manuring on texture and moisture content, with mechanical analyses, have been the chief lines.

An extended series of rotation experiments, with and without manure, and with plats for continuous cultivation with the same crops for comparison, has been planned and the work begun: thus supplementing the plans along same lines begun in former years.

Field experiments with the following farm crops have been carried out: Wheat, oats, corn, kafir, sorghum, cotton, castor beans; cow peas, soy beans, and rape; sugar and stock beets: alfalfa, red and alsike clovers, and a number of grasses. In general, these tests have included comparison of varieties, methods of preparation of the soil and after-cultivation: time, mode, thickness, and disposition of seed: deep, shallow, frequent and infrequent cultivation: time of harvesting.

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There have also been a large number of small plat tests of many varieties of native or imported grasses and other forage plants.

Feeding experiments with cattle and hogs have been continued, and the breeding of Jersey and Short-horn grades and crosses among cattle; Berkshire, Jersey-duroc, and Poland China hogs; have been begun. Feeding experiments have been mainly comparisons of corn and kafir grains prepared in different ways, and in mixtures with cotton seed and bran with tests of various forms of rough forage for the cattle.

Observations of the rate of growth as influenced by temperature and moisture of corn and kafir have been carefully made. In co-operation with the chemical department, the composition of corn, kafir, and alfalfa at different cuttings has been studied.

In the Horticultural Department, aside from the care of the large apple and peach orchards, and vineyard, a small stock of apple, peach and apricot trees has been grown in nursery. The care, so far as this Station is concerned of an experiment in the cultivation of forest trees from seeds and nuts obtained from this Territory and a number of states, which was instituted by the United States Department of Agriculture, has been assigned to the Horticulturist and the work started.

Satisfactory results in forcing the growth of apple trees are reported as the result of careful cultivation. Root-pruning of apricot and peach trees is also believed to have given encouraging results. An abundant crop of grapes gives promise of a good opportunity for comparing the fruit of the large number of varieties being tested. Excellent results are reported in the culture of strawberries, dew-berries and blackberries, with unsatisfactory results as to raspberries.

Truck gardening has been carried on to a moderate extent, with a study of varieties and methods of culture. Attention has also been given to Floriculture, more particularly with hardy bulbs and roses.

The Horticulturist has also had supervision of the grounds about the Station and College buildings, and has made tests of various grasses and clovers, reporting fairly satisfactory results as to the red, alsike and white clovers, blue Bermuda and orchard grass, and timothy.

In the department of Botany and Entomology, a good beginning has been made in the work of securing a collection of the plants of the Territory. About one thousand species of insects have also been added to the Station collection. Studies have been made in the life history of several insects. During the summer of 1896, "chinch bug infection" was sent to one hundred and forty-two farmers in the Territory, and it was applied on the station fields, where also the trap and barrier method of destroying chinch bugs was tested. Few reports of results were received from farmers; no immediate effect was seen at the Station. The disease has appeared at the Station and in different parts of the Territory in the spring of 1897.

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Only thirty requests for the infection have been received during the spring of 1897.

Many inquiries have been received in regard to plants and insects, which have been answered as promptly and fully as possible.

The work of the Department of Chemistry has continued along the lines formerly pursued. Investigations concerning the following are being conducted: Composition of weekly samples of maize and of two varieties of kafir; composition of alfalfa at different cuttings; plant food removed by castor beans; study of analytical methods for the extraction of oil from castor beans and of methods for the determination of nitrogen in fertilizers containing nitrates; examination of river, well, and pond waters as to fitness for irrigation purposes; analyses of potable waters, and miscellaneous work on samples brought in by farmers for examination.

Over 2,500 determinations have been made during the year; the results of some of the investigations have already been published and reports on a number of the others will be issued in the near future.

Work has been carried on in co-operation with other departments of the Station when found desireable, it being reported by the department having the investigation in charge. It is intended that feeding experiments to determine the digestion coefficients of forage crops peculiar to Oklahoma be made as soon as facilities for the work can be procured.

The Veterinarian of the Station was also Territorial Veterinary Surgeon until March, 1897. In his double capacity, he did much work in investigating outbreaks of Texas fever in cattle and in studying the progress of the disease. A number of cases of glanders were studied and tests of mallein as a means of detecting this disease made. Several cases of symptomatic anthrax were reported and investigated.

During the year, the following bulletins have been issued and distributed to those requesting them.

BULLETIN No. 21—September, 1896.

EXPERIMENTS IN CORN CULTURE—1896.

The following experiments with corn were reported: Test of varieties; time and method of planting; thickness of planting; method of culture; rate of growth of stalks; percentage of moisture in shelled corn.

ROAD MAKING AND REPAIRING.

Suggestions concerning the most economical methods of managing roads, keeping them in repair, and the opening of new roads.

BULLETIN No. 22—January, 1897.

CLIMATE AND CROPS IN OKLAHOMA.

Records are given of the range of temperature and the rain-fall at the Experiment Station and at seventeen stations in Oklahoma for 1896. The localities best suited to the growing of Indian corn, kafir corn, wheat, oats,

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barley, rye, cotton, castor beans, roots and tubers, millet, cow peas, soy soja or Japan beans, grasses, clovers, alfalfa, and teosinte, are briefly stated, together with short suggestions concerning the value of the different crops.

EXPERIMENTS WITH KAFIR CORN—1896.

Brief statements of the yields of the white and the red varieties with thick and thin, early and late, planting, and a note on the feeding value and acreage of kafir corn.

BULLETIN No. 23—February, 1897.

COTTON CULTURE IN OKLAHOMA.

Varieties best suited to certain localities, character of soil and tillage, distance between rows, best implements to use in cultivation, yields, value of seed, and acreage of cotton desireable for Oklahoma farmers; together with notes of experience of practical cotton growers in Cleveland, Oklahoma, Lincoln, and Blaine Counties.

BULLETIN No. 24—May, 1897.

OKLAHOMA SOIL STUDIES.

A practical resume of what is known about the soils of the Territory, their weight per cubic foot, water content; effect of subsoiling, of rolling, and of different methods of cultivation. Monthly averages of soil moisture and soil temperature are also given, as well as the mechanical analysis of several typical soils.

BULLETIN No. 25—June, 1897.

LOSS BY EXPOSURE OF CORN STOVER AND TEOSINTE.

Feeding value lost by leaving in shocks instead of stacking.

COMPOSITION OF "PIE MELON."

Analysis and feeding value of pie melons as compared with corn silage, corn fodder, corn stover, and carrots.

FERTILIZER ANALYSES OF CASTOR BEAN PLANTS.

Brief report of preliminary determinations of the plant-food removed from the soil by this crop.

BULLETIN No. 26—June, 1897.

SOME INJURIOUS ORCHARD INSECTS.

Methods of preparing Bordeaux mixture and kerosene emulsion are given, together with advice in regard to spraying apparatus. Description of and remedies for the following insects are given: Peach-tree borer, Bumble flower beetle, Bag worm, Round-headed and Flat-headed apple tree borer, Fruit tree Beetle, Grape-vine leaf roller, Spotted vine chafer, Codling moth, Plum curculio, Twig girdler, Apple twig borer, Tent cater pillar, Apple leaf crumpler, and others.

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BULLETIN No. 26—June, 1897.

GLANDERS, TEXAS FEVER, AND SYMPTOMATIC ANTHRAX.

Brief statements of the causes, symptoms, and treatment of these diseases, together with a map of Oklahoma showing location of National and Oklahoma quarantine lines, along with a report of an experiment with mallein as a diagnostic agent for glanders.

BULLETIN No. 28—June, 1897.

EXPERIMENTS WITH WHEAT, 1896-7.

Statements of the yield of different varies, effect of date of sowing, of subsoiling, of rolling, and of varying amounts of seed per acre are given.

In addition, a number of "press bulletins," giving synopses of the regular bulletins and Station notes, have been sent to the newspapers of the Territory.

G. E. MORROW, Director.

FINANCIAL STATEMENT.

Oklahoma Agricultural Experiment Station,

In Account With

The United States Appropriation, 1896-7,

DEBTOR.

To receipt from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1897, as per act of Congress approved March 2, 1897		$ 15.000 00

CREDITOR.

By Salaries	abstract 1,	$ 5,180 04	
Labor	abstract 2,	3,253 83	
Publication	abstract 3.	995 02	
Postage and stationery	aestract 4,	141 70	
Freight and express	abstract 5,	197 48	
Heat, light, and water	abstract 6,	106 45	
Chemical supplies	abstract 7,	97 85	
Seeds, plants, & sundry supplies,	abstract 8,	347 86	
Fertilizers	abstract 9,	00	
Feeding stuff	abstract 10,	252 80	
Library	absIract 11,	3 00	
Tools, implements, & machinery,	abstract 12,	378 22	
Furniture and fixtures	abstract 13,	590 95	
Scientific apparatus	abstract 14,	1,657 75	
Live stock	abstract 12,	611 68	
Traveling expenses	abstract 16.	161 45	
Contingent expenses	abstract 17,	18 65	
Buildings and repairs	abstract 18,	606 70	
Balance			$ 398 57

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LIST OF BULLETINS.

The following have been issued since the organization of the Station. Copies may be obtained, so long as the supply lasts, of those not designated with an asterisk (*).

*No. 1, December, 1891.—General information, organization, and history.

No. 2, March. 1892.—Record of progress and details of plans.

No. 3, June, 1892.—Station notes: Insects.

*No. 4, October. 1892.—Test of varieties; oats, corn, spring wheat, Irish and sweet potatoes.

*No. 5, January, 1893.—Some soil analyses.

*No. 6, May, 1893.—Notes of progress; Analyses.

No. 7, July, 1893.—Water analyses.

No. 8, October, 1893.—Test of varieties of wheat.

No. 9, January, 1894.—Test of varieties of vegetables, 1893.

No. 10, April, 1894.—Corn—report of experiments.

*No. 11, July, 1894.—Press bulletin excerpts.

No. 12, September, 1894.—Wheat—report of experiments.

No. 13, December, 1894.—Wheat feeding.

No. 14, January, 1895.—Grapes, 1894.

No. 15, February, 1895.—Garden vegetables, 1894.

No. 16, March, 1895.—Oats—report of Experiments.

*No. 17, March, 1894.—Oklahoma weeds.

No. 18, April, 1896.—Irrigation for Oklahoma.

*No. 19, April, 1896.—Methods of destroying chinch bugs.

*No. 20, June, 1896.—Wheat experiments, 1895-6; Food value of corn scorched by hot winds; Fruit culture in Oklahoma; Peach rosette; The melon louse.

No. 21, September. 1896.—Experiments in corn culture, 1896; Road making and repairing.

No. 22, January, 1897.—Climate and crops in Oklahoma; Field experiments with kafir corn.

No. 23, February, 1897.—Cotton culture in Oklahoma.

No. 24, May, 1897.—Oklahoma soil studies.

No. 25, June, 1897.—Loss by exposure of corn stover and teosinte; Composition of pie melon; Fertilizer analyses of castor bean plant.

No. 26, June, 1897.—Some insects injurious to orchards.

No. 27, June, 1897.—Glanders, Texas fever, and symptomatic anthrax.

No. 28, June, 1897.—Experiments with wheat, 1896-7.

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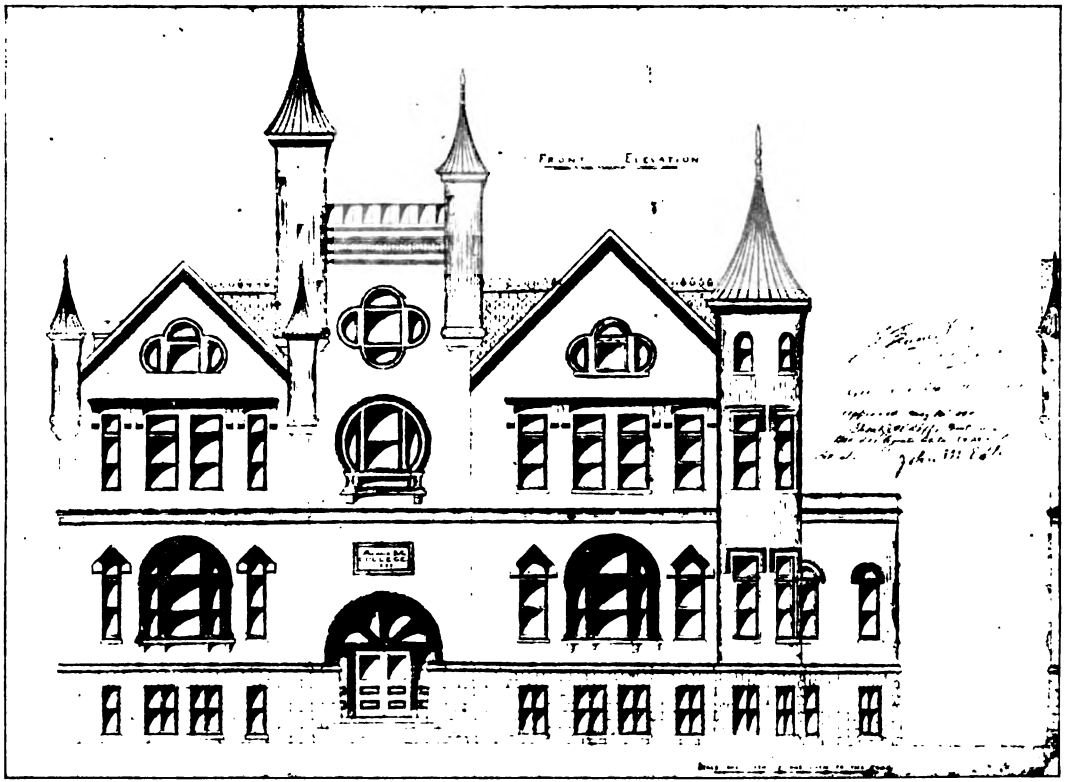

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OKLAHOMA

AGRICULTURAL AND MECHANICAL

COLLEGE.

AGRICULTURAL EXPERIMENT STATION.

REPORT, 1898--1899.

In addition to the annual report, this volume contains (beginning with page 46) a summary of the results of the most important work done since the establishment of the station.

Stillwater, Oklahoma.

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OKLAHOMA

AGRICULTURAL AND MECHANICAL COLLEGE.

AGRICULTURAL EXPERIMENT STATION,

Organization, 1898--99.

BOARD OF REGENTS.

GOVERNOR C. M. BARNES, ex-officio, ... Guthrie
HON. R. A. LOWRY, President, to Nov. 10, 1898 ..... Stillwater
HON. B. S. BARNES, President, Nov. 10 1898, to Mar. 13, 1899..... Ponca City
HON. F. J. WIKOFF, President, Mar. 13. 1899, to date,..... Stillwater
HON. W. F. BORT, to Nov., 1898,..... Kingfisher
HON. R. J. EDWARDS, to Mar., 1899,..... Oklahoma City
HON. C. J. BENSON, Treasurer,..... Shawnee
HON. J. C. TOUSLEY,..... Weatherford
HON. J. P. GANDY, from March 13, 1899,..... Alva
HON. J. D. BALLARD, from Mar., 13. 1899,..... Weatherford

STATION STAFF.

G. E. MORROW, M. A.,..... Director and Agriculturist
H. E. GLAZIER,..... Vice-D rector and Horticulturist
G. L. HOLTER, B. S., ... Chemist
E. E. BOGUE, M. S. ..... Botanist and Entomologist
L. L. LEWIS, M. S., D. V. M..... Veterinarian
JOHN FIELDS. B. S ,. ..... Associate Chemist
J. H. BONE, B. S.,..... Associate Agriculturist
O. M. MORRIS, B. S.,..... Assistant in Horticulture
A. G. FORD, B. S.,..... Assistant in Chemistry
H. M. HAND, ... Clerk
MISS G. M. HOLT,..... Stenographer

STATION STAFF, FROM JULY 1, 1899.

JOHN FIELDS, B. S.,..... Director and Chemist
E. E. BOGUE, M. S.,..... Botanist and Entomologist
L. L. LEWIS, M. S., D. V. M.,..... Veterinarian
F. C. BURTIS, M. S.,..... Agriculturist and Horticulturist
O. M. MORRIS, B. S.,..... Assistant Horticulturist
A. G. FORD, B. S.,..... Assistant Chemist
H. M. HAND,..... Clerk
MISS G. M. HOLT,..... Stenographer

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EXCHANGE
MICHIGAN STATE College
MAR 22 '40

OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE.

RESOURCES.

The Oklahoma Agricultural and Mechanical College receives from the U. S. Government every year the sum of $22,500. This is known as the "Morrill Fund," and is to be expended for instruction and appliances only, the Territory of Oklahoma providing buildings, repairs, etc.

The Agricultural Experiment Station, which is a department of the College, receives from the United States Government an annual appropriation of $15,000, to be used solely for experimentation and the publication of results.

The last Territorial Legislature provided for the levy of one-tenth of a mill on the taxable property of the territory for the benefit of the college. This, it is estimated, will reach $4,500. It also set apart one-fifth of the income derived from the leasing of lands reserved for the higher educational institutions, estimated to reach $4,800. There are other slight sources of income, not necessary to detail here, which raise the total income of the college and station to about $50,000.

The last legislature also made an appropriation of $20,000, for building purposes.

EQUIPMENT.

A main central building and four outlying buildings are now occupied for purposes of instruction and experimentation. Work is being pushed upon a commodious brick building for the department of chemistry, and the contract is let for a handsome library building which will also accommodate the department of English and foreign languages, and the several departments of biology.

In the chemical and physical laboratories; in the departments of biology—botany, zoology, entomology, etc.; in the lines of agriculture, horticulture, veterinary science and bacteriology; and in the departments of general culture and literature, the appliances,

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models, instruments, collections, and illustrative apparatus of all kinds are extensive, modern and well selected. The following statement of equipment is from the report of the Governor to the last legislature, and represents present values:

Department.	Value of apparatus.
Physics	$ 660.90
Chemistry	6,777.32
Botany and entomology	3,472.76
Veterinary science	2,289.90
English	149.60
Mechanic arts	7,171.39
Mathematics and civil engineering	942.10
Typewriting	260.00
Library	10,093.71
Preparatory	500.00
Agriculture, horticulture, furn. and fixt.	500.00
Total	$32,817.68

Since the above was written additional outlays for a department of printing, and for the equipment of an electrical plant, have raised the value of equipments to $40,000 in round numbers.

ADMISSION TO THE COLLEGE.

Applicants for admission to the college must be fourteen years of age. This applies to the preparatory as well as to the college department.

In order to be admitted to the freshman class, applicants must pass a satisfactory examination in arithmetic, geography, English grammar, United States history and reading. There is a preparatory department where a course of study is arranged for the purpose of training students for admission to the college classes. Applicants for admission to higher classes are examined in the work gone over by the class which they wish to enter.

FACULTY.

The College has a faculty of fifteen members, each specially trained in the department or division under his charge.

COURSES OF STUDY.

The preparatory department covers two years of instruction and gives careful training in reading, writing, arithmetic, grammar, geography, history, civil government and drawing.

Following is a *resume* of the several courses in the collegiate department:

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1. General Science and Literature Course: *Freshman class.* Rhetoric, etymology, German or Latin, algebra, physical geography and meteorology, physiology, physics, book-keeping, drawing and shop practice.

Sophomore class. Advanced rhetoric and theme work, German or Latin, geometry, trigonometry, chemistry, zoology, comparative anatomy, and botany.

Junior class. English and American literature, German or Latin, physics, entomology, the political and social history of the United States, agriculture or the mechanic arts.

Senior class. Civics, sociology, economics, psychology, the elements of law, geology, bacteriology, literature and criticism, and general history.

2. The Course in Agriculture: This is identical with the general course throughout the Freshman and Sophomore years. In the Junior year the special studies (in addition to such general studies as can be carried) are soils and crops, breeds and breeding, dairying, and agricultural chemistry; in the Senior year, farm equipment and management, feeds and feeding, advanced physiology or horticulture, agricultural history and diseases of animals.

3. Course in Mechanic Arts: This is identical with the general course through the Freshman year. In the Sophomore year special studies are descriptive geometry, mechanical drawing and surveying; in the Junior year analytical geometry, calculus, applied mechanics, steam boilers, machine designing, mechanical physics, and mechanical shop work; in the Senior year calculus, thermodynamics, electrical engineering, civil engineering, machine designing, and dynamo laboratory work.

4. Specialized Course in Biology: This course has minor divisions of botany, zoology, and bacteriology, and in the line chosen the student has two years (Junior and Senior) of special advanced training, with proper correlated studies.

5. Specialized Course in Chemistry: Identical throughout the Freshman and Sophomore years with the general course. The Junior and Senior years furnish a technical yet comprehensive and practical course in chemistry, with constant laboratory practice. Scientific German is included, as well as a reasonable amount of attention to literature, the higher mathematics, etc.

There is also in connection with the agricultural course provision for special training in horticulture, embracing forestry, fruit culture, floriculture, etc.; and—also in connection with the agricultural course—provision for special training in veterinary science.

The college also offers instruction in the following special studies: Stenography and typewriting, book-keeping and other commercial studies, printing, and vocal and instrumental music.

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EXPENSES.

Tuition is free in all the regular courses. An incidental fee of $1.00 per term is charged all students. A small fee is charged for the use of piano or typewriter. Board and room can be had for from $2.50 to $3.00 per week. Students' clubs are in operation in which good board is obtained for $1.75 to $2.00 per week. Books cost from $2.00 to $5.00 per term. Energetic students can in a measure support themselves by doing work about the college and city.

CALENDAR—1899-1900.

Entrance Examinations September 11-12.

Fall Term opens September 13; closes December 20.

Winter Term, entrance January 2; opens January 3; closes March 24.

Spring Term, examinations March 27; opens March 28; closes June 6.

The catalogue will be sent to all who request it. Communications should be addressed to

A. C. SCOTT, PRESIDENT,
Stillwater, Okla.

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AGRICULTURAL EXPERIMENT STATION.

ANNOUNCEMENT.

The Oklahoma Agricultural Experiment Station is a department of the Oklahoma Agricultural and Mechanical College. It receives no funds from the Territory and is supported by an annual appropriation of $15,000 from the National Treasury.

The act of Congress establishing this and similar institutions defines their duty in the following language:

"That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories."

Due regard to the conditions and needs of this Territory has determined which of these permissible investigations should be pursued by this Station. And due regard for careful work and results of ultimate value has made the choice of a few definite lines pursued to their end preferable to a little work on each of a great many lines.

The proper work of the Station is, therefore, to determine and suggest applications of general principles rather than to formulate rules of practice. The work of the Station should be of value to the largest possible number rather than to a few individuals. This fact and the limitations of time make it impossible for the Station to undertake investigations unless it is probable that the results will be valuable to many.

Suggestions as to desirable lines of work are invited and will be carefully considered when planning future experiments.

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The Station will gladly give any information in its possession on any subject connected with agriculture, in response to request.

Members of the station staff will aid in the work of farmers' institutes whenever possible.

A cordial invitation is extended to all to visit the Station at any time and inspect the work which is being done.

The bulletins of the Station are now sent to more than 13,000 farmers and others. They are sent, without charge, to any one in the Territory sending name and address.

Address all communications to

AGRICULTURAL EXPERIMENT STATION,
Stillwater, Oklahoma.

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OKLAHOMA AGRICULTURAL EXPERIMENT STATION.

REPORT OF DIRECTOR FOR THE YEAR ENDING JUNE 30TH. 1899.

The organization of the Station Staff during the year has been without change as follows:

GEORGE ESPY MORROW, M. A. Director and Agriculturist.
HENRY E. GLAZIER, Vice Director and Horticulturist.
GEORGE LATIMER HOLTER, B. S. Chemist.
ERNEST EVERETT BOGUE, M. S. Botanist and Entomologist.
LOWERY LAYMON LEWIS, M. S., D. V. M. Veterinarian.
JOHN FIELDS, B. S., Associate Chemist.
JOHN HAYES BONE, B. S. Associate Agriculturist.
OSCAR M. MORRIS, B. S., Assistant in Horticulture.
AUGUSTUS G. FORD, B. S., Assistant in Chemistry and Meteorological observer.
HENRY M. HAND, Clerk.
GEORGINA M. HOLT, Stenographer.

Each of the persons named with the exception of Mr. Ford has held corresponding positions in the college work. There have been frequent changes in the Board of Regents of the college and station, but these have not affected or changed the policy or the work. Increasing experience has added to the efficiency of the staff hitherto employed and much needed additional help has made it possible to enlarge and increase the value of the work in some directions. Under such conditions as those that exist at this institution it is believed that the plan of having the larger part, if not all, of the station staff also engaged in college work is a desirable one. This tends to bring the two classes of work more closely together and to increase the interest taken in the station by the more advanced students of the college. In some cases one person has been able to discharge certain duties both of college and station when a reasonable use of available funds would not have justified the employment of two persons for the work if divided. In a somewhat noticeable degree some advanced students of the college have done work which in many stations is assigned to regularly employed assistants. This fact adds to the pay roll and reduces the direct salary list.

One of the most serious needs of the station still remains, that of greater facilities for doing its work in the matter of buildings for offices, laboratory work and for experiment work with live

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stock. A small green house and a temporary building for use in feeding and breeding poultry have been erected during the past year. Work is now in progress upon two relatively large and well arranged buildings to be completed during the coming year, for the combined use of the college and station, which will add greatly to the convenience of the workers and enable certain new lines to be taken up and successfully prosecuted.

There has been a noticeable and steadily increased manifestation of interest in the work as shown by the large increase in the correspondence addressed to the station authorities for information on many lines of work undertaken as well as upon a considerable number of subjects not directly within the scope of the station work. The demand for the bulletins of the station steadily increases. The regular edition is now 13,500. The supply of most of the bulletins issued in the past is practically exhausted. Because of this and to place the information gained in the past in a more readily available form a somewhat extensive summary of the work done along leading lines since the organization of the station has been compiled, chiefly by Director-elect John Fields and appears in connection with this report. Matter prepared for a bulletin on Feeding experiments and one upon Wheat experiments in 1898-9 is published as a part of this summary.

In addition to the regular bulletins frequent press bulletins have been published during the year. These have been copied by newspapers in the territory as well as by agricultural papers in different portions of the country. Considerable extracts from the regular bulletins have also been so published and in some cases the entire bulletins have been copied by territorial papers of large circulation.

The following bulletins have been issued during the year:

No. 35. Summary of Digestion Experiments with Kafir.

No. 36. Summary of Experiments with Corn and Wheat, by G. E. Morrow and J. H. Bone.

No. 37. Digestion Experiments with Steers, by Geo. L. Holter and John Fields.

No. 38. Analyses of Waters for Irrigation, Geo. L. Holter and John Fields.

No. 39. Texas Fever, by L. L. Lewis.

No. 40. Bacteriology of Milk, by L. L. Lewis.

No. 41. Weeds of Oklahoma, by E. E. Bogue.

No. 42. Oklahoma Soils, by J. H. Bone.

Feeding Experiments, and Wheat Culture Experiments, 1898-9, by G. E. Morrow and J. H. Bone, (in summary).

A legal controversy concerning the printing of bulletins, the station holding that unreasonably high prices were charged for the work under the contract for printing made by the Territorial Legis-

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lature in 1897, prevented the publication of extended bulletins until April, 1899.

THE WORK OF THE YEAR.

Climatic conditions during both the calendar year 1898 and fiscal year here reported on were favorable for outdoor work. The rainfall at the station during 1898 was 42.62 inches, probably the largest rainfall in any year since the establishment of the station. With the exception of a portion of April and of November the ground did not become notably dry at any period, and except a somewhat excessive rainfall in May and July, the precipitation was fairly well distributed throughout the year. The rainfall for the first six months of 1899 has been 16.18 inches, certainly a full average amount and, excepting for a time in the early part of April, with a satisfactory distribution.

The temperature record both for 1898 and the first half of 1899 was also quite satisfactory as a whole. The mean annual temperature at the station for 1898 was 58.6 degrees, with 36 degrees in December as the lowest and 79 degrees in July as the highest mean. The maximum temperature was high during the summer months; 95 degrees on June 25, 97 on July 28, 96 on August 23, 97 on September 26, and 99 the highest temperature of the year on October 3rd. The lowest temperature recorded in the territory since its opening to settlement was on February 11-12, 1899. The record at the station was minus 17 degrees. In more northern and western parts the temperature showed from two to five degrees below this. While some injury was caused to fruit buds, it is an interesting fact that there is a fair crop of peaches, and probably the largest crop of apples ever known in the territory, and that no other budded or fine fruits received any special injury except blackberries to some extent.

AGRICULTURAL DEPARTMENT.

During the year the agricultural department of the station has had the following experiments in progress:

Soils. Temperature, daily record. Moisture, daily record. Effects of plowing and subsoiling, of time of plowing, of manuring, of rolling. Comparison of moisture of bottom and uplands. Effect of methods of cultivation on moisture. Physical properties of soil. Evaporation from water surface. Transpiration of water by plants. Water evaporation from the plant and soil for pound of dry matter produced.

Indian Corn. Test of varieties. Effect of time of planting. Thickness of planting. Methods of cultivation. Time of plowing. Deep and shallow plowing. Subsoiling. Manuring. Germination at different depths and dates. Root growth and root pruning.

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Rate of growth and chemical composition at different stages of growth.

Kafir Corn. Test of varieties. Effect of time of planting. Thickness of planting. Germination at different dates and depths. Rate of growth and chemical composition at different dates. Root growth and root pruning.

Sorghum. Test of varieties. Germination at different dates and depths.

Wheat. Test of varieties. Effect of time of seeding. Quantity of seed. Method of seeding. Time of plowing. Depth of plowing. Manuring. Germination at different dates and depths.

Oats. Test of varieties. Germination at different dates and depths.

Cow-peas. Test of varieties. Methods of planting. Thickness of planting. Planting after wheat. Germination at different dates and depths.

Soy Beans. Thickness of planting. Methods of planting.

Cotton. Test of varieties. Effect of time of plowing. Thickness of planting. Selection of seed. Germination at different dates and depths.

Castor Beans, same as with cotton.

Alfalfa. Test of varieties. Effect of time of planting. Germination at different dates and depths and chemical composition at different cuttings.

Grasses. Test of varieties, tame and native. Study of native grasses.

Sugar beets, peanuts, sweet potatoes, buckwheat, millet, clover, sunflowers, lentils, flat peas, field peas, vetch, velvet beans, Australian salt bush. Test of varieties.

Forage crops. Yield at different dates. Effect of thickness of planting. Test of value for feeding.

Corn, Kafir, cotton, castor beans, alfalfa, wheat. Effect of continued cultivation on one-half acre plats.

The following series of one-half acre rotation and continuous cultivation of plats has been especially with the design of continuing the work in the indefinite future.

Rotation of crops.

Plats 1-2. Continuous Wheat Culture. Plat 1 Manured.

Plat 3. Varying Rotation.

Plats 4-6. Continuous Cotton Culture. Plat 4 Manured.

Plats 6-7. Continuous Culture Castor Beans. Plat 6 Manured.

Plat 8. Grass.

Plats 9-10. Continuous Culture Corn. Plat 9 Manured.

Plat 11. Two Year Rotation: Corn and Cow Peas. Wheat.

Plat 12. Two Year Rotation: Corn and Cow Peas. Cotton.

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Plat 13. Three Year Rotation: Corn and Cow Peas. Corn. Oats.

Plat 14. Three Year Rotation: Corn and Cow Peas. Corn. Wheat.

Plats 15-16. Continuous Culture Kafir. Plat 15 Manured.

Plat 17. One Year Rotation: Kafir and Cow Peas.

Plat 18. Two Year Rotation: Kafir and Cow Peas. Wheat.

FEEDING EXPERIMENTS.

Cattle. Comparison of Corn and Kafir corn. Of light and heavy feeding. Effect of different foods given to dairy cows. Rate of gain on pasture.

Hogs. Comparison of Indian and Kafir corn. Feeding corn with cultivated forage crop. Alfalfa as pasture, with and without corn feed. Weights and gains of pigs of different ages.

Sheep. Fattening sheep on Kafir, ground and unground. Gain of sheep on prairie pasture. Weight and rate of gain of lambs at different ages.

HORTICULTURAL DEPARTMENT.

With increased assistance this department was able to very considerably increase its direct experiment work. In addition to the general care of the orchard and garden plantation this department has had the following experiments under progress:

Orchard cultivation.

Pruning trees when transplanting.

Pruning bearing peach trees, season and method.

Spraying potatoes.

Cultivation of potatoes.

Planting potatoes, method, time.

Cultivation of cabbage.

Cultivation of onions.

Variety test and cultivation of tomatoes.

Variety test of pole and bush beans.

Cultivation of blackberries and raspberries.

This department has also had care of the forestry plantation work under the direction of the U. S. Department of Agriculture, in which gratifying success has been secured thus far, giving good hopes of the easy possibility of making forestry plantations with a considerable variety of deciduous trees on the average upland prairies of at least eastern Oklahoma. With the beginning of the next fiscal year the entire management and direction of this forestry work will be placed in the hands of the station.

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DEPARTMENT OF BOTANY AND ENTOMOLOGY.

Bulletin No. 41, on Weeds of Oklahoma has been prepared by this department during the year.

Facilities for the work have been improved by assigning this department rooms in the building formerly occupied as residence by the Vice Director. A collection of about 600 species of plants growing without cultivation in the territory has been made. In all, the department has a collection of over 2,400 species and a considerable collection of seeds.

Chinch bug infection has been distributed to all applicants. The number of requests for such infection has noticeably decreased, there being but one-sixth as many in 1898 as in 1896. Up to close of fiscal year comparatively few requests have been received in 1899. On the station farm considerable numbers of infected bugs were found in 1898 and 1899 without direct application of the infection. The largest number of requests for this infection have come from Garfield, Kingfisher, Canadian and Oklahoma counties. Experiments with various oils for killing chinch bugs have been made but without satisfactory results.

The food of the horned toad has been investigated and it has been found that it is largely of chinch bugs during a part of the season; 235 chinch bugs having been taken from the stomach of one toad.

An extensive collection of the insects of the territory has been made and prepared for convenient reference.

The applications to the department for information have rapidly increased—nearly four times as many inquiries being received in 1898 as in 1896.

DEPARTMENT OF CHEMISTRY.

This department has continued its work on the river and well waters of the territory in determining their fitness for purposes of irrigation. The results of this work have been published and furnish exact and needed information along a line about which there is much inquiry.

During the year, a series of 18 separate digestion trials of different forage crops was made with sheep. The results of this work have been computed and when confirmed by further research, will add to our knowledge of the forage crops peculiar to this region. In this same connection, the chemical composition of Kafir corn is being studied in the laboratory. Examinations of rocks and minerals still consume too much of the time of this department, more than 200 samples having been examined qualitatively during the year.

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More than 100 complete fodder analyses were made during the year, reported in Bulletin No. 37.

VETERINARY DEPARTMENT.

Study of methods of preventing fever among cattle has occupied much of the time of the Veterinary Department during the year. A considerable series of experiments of dipping cattle to destroy cattle ticks was carried on at Noble, in the extreme southern portion of the Territory, and using vats constructed by the station at this point, and also a series of experiments in inoculation of cattle brought from the north to determine how far this might be an effective means of preventing an attack of the fever. Reports of this work are shown in Bulletin No. 39.

Some investigation was made of diseases affecting horses in the central portion of the territory, with the conclusion that it was caused by smut on some prairie grasses.

This department has also made very careful study of the bacteriology of milk and of the pasteurizing of milk. The results of which are published in Bulletin No. 40.

The correspondence in this department has largely increased. Inquiries concerning the nature and treatment of different diseases, and letters reporting supposed outbreaks of contagious diseases have been frequent.

MISCELLANEOUS WORK.

Members of the station staff have attended and addressed a considerable number of territorial and local agricultural, horticultural and live stock meetings and farmers' institutes. Somewhat earnest efforts have been made to secure greater interest in farmers' institutes but without great success. They have also contributed to agricultural and horticultural periodicals, replying to special inquiries or discussing questions of interest.

A considerable change in the organization of the station staff is made at the close of this fiscal year—the Director, Vice Director and Asso. Agriculturist retiring from the work and the Chemist being assigned full work in the College. Asso. Chemist, John Fields, has been elected Director and Chemist, positions for which he is eminently fitted by ability, education, special training and experience in station work. The other efficient members of the staff retain their former positions. Arrangements for the work of Agriculturist and Horticulturist have not yet been made.

With a competent and experienced staff, with greatly enlarged

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facilities for work in the matter of buildings, with rapidly increasing collections of apparatus, the station will be able to do more and more valuable work in the interests of the chief industry of Oklahoma—agriculture in all its phases—and is heartily commended to the confidence and support of the people of the territory.

June 30, 1899. G. E. MORROW, Director.

FINANCIAL STATEMENT.

Oklahoma Agricultural Experiment Station in Account With The United States Appropriation, 1898-9.

Dr.

To Balance on hand July 1, 1898	$ .93
To Receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1899, as per Act of Congress approved March 2, 1887	15000.00
Total	$15000.93

Cr.

By Salaries	$ 6855.00
Labor	2634.55
Publications	2006.30
Postage and stationery	109.08
Freight and express	152.64
Heat, light and water	219.71
Chemical supplies	110.45
Seeds, plants, and sundry supplies	893.46
Feeding stuffs	297.92
Library	2.00
Tools, implements, and machinery	190.65
Furniture and fixtures	165.87
Scientific apparatus	219.83
Live stock	63.40
Traveling expenses	320.07
Contingent expenses	10.00
Building and repairs	750.00
Total	$15000.93

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Station Sale Fund.

Dr.

To Amount on hand July 1, 1898	$ 1275.94
Receipts from other sources than the United States	1046.63
Total	$ 2322.57

Cr.

By Salaries	$ 120.00
Labor	2.65
Building and repairs	331.57
Balance	1868.35
Total	$ 2322.57

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FEEDING EXPERIMENTS.

1896—1899.

G. E. Morrow and J. H. Bone.

SUMMARY AND GENERAL CONCLUSIONS.

Oklahoma is well adapted to rearing and feeding horses, cattle, sheep and hogs. Few things would add more to its prosperity than a large increase of attention to stock rearing by a majority of its farmers.

Where corn can be raised with reasonable certainty of a good crop it will be found the best fattening food. Its fodder and stover are also valuable foods, although the long time after ripening before winter feeding begins causes more loss in the shock and much more to the standing stalks than in more northern states.

As the kernels become very hard when thoroughly dried, grinding the corn is a help; soaking is a fair substitute for this. Where hogs follow cattle there is little loss when either ear or shelled corn is fed.

Kafir corn is a healthful, palatable and nutritious food, but its feeding value is somewhat less than that of corn. As shown both by feed lot trials and by digestion experiments there is a great loss in feeding this grain unthrashed to cattle—in some cases of sixty per cent. but hogs will utilize most of this waste. There is little difference in the waste whether the grain is fed unthrashed or thrashed. In some cases, at least, the loss is greater when soaked grain is fed than when it is fed dry. In some trials steers fed Kafir meal made better gains for a long time than did those fed corn meal, but this was not true in any extended period. Hogs digest the unground grain better than do cattle. In general hogs have made gains from four-fifths to five-sixths as great when fed on Kafir as when fed corn. Sheep seem to digest Kafir better than any other class of farm animals.

Kafir stover apparently has practically the same feeding value as corn stover, and often is in better condition. Running the entire stalk through a thrashing machine puts the stover in excellent condition.

Alfalfa is the best hay for either horses, cattle or sheep and is a help to hogs during winter. The value of cowpea and soy bean hay is underestimated by most Oklahoma farmers. No larger gains have been made by cattle at the station than when cowpea hay was their only rough forage.

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The trials at the station indicate that it is not profitable to keep good grade native steers until they are three years old and that it is possible that sales when they are "long yearlings" may be most profitable.

Apparently six months is as long as it is profitable to continue full grain feeding of cattle under existing conditions. The rate of gain decreases as the animals become fat and the quantity of food needed to produce a pound of gain greatly increases in many cases.

The result of one trial suggests possibility of greater profit when steers are not given all they can eat of grain, taking a longer period for fattening. This would pretty certainly be true where there is an abundant supply of good alfalfa or cowpea hay, and grain is high priced.

One or two striking illustrations of the fact that an ill-formed animal may make as large gains as well formed ones have been found in the station feeding trials. The lower price at which the ill-formed steer sells will more than counterbalance any seeming profit from his purchase.

Oklahoma native pastures are good, but the gains made by cattle on them, especially when flies are bad or there is extreme heat, are often over-estimated. It is desirable to have sorghum, Kafir or corn with which to supplement the pastures during the fall or summer drought.

Alfalfa is excellent as pasture for hogs. Pigs will make some gain with no other food; excellent gains when fed grain while on the alfalfa. Continuous pasturing will injure and may destroy the alfalfa. With rare exceptions, alfalfa should not be pastured the year it is sown. Sorghum also makes a fair pasture for hogs. Sowing cowpeas, planting peanuts or sweet potatoes and allowing hogs to harvest the crop giving them some grain in addition reduces the cost of pork production. Sugar beets are much relished by any class of stock. The greater cost of growing them as compared with other crops makes it doubtful if they are an economical crop when used in large quantities.

A large increase in the number of sheep in the territory is advised. They thrive well, the cost of keeping in summer is very small, and Oklahoma has many advantages as regards the production of lambs for the early spring market.

Shelter should be provided for all classes of stock, but expensive buildings and stall feeding of cattle are not necessary. While there is, occasionally, extreme cold, ordinarily protection from rain and cold winds by means of simple sheds is all that is needed for the comfort of farm animals.

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The long continued feeding of hogs on dry feed of any class is not advisable. Almost without exception the grain eaten for each pound of increase somewhat rapidly increases after hogs of any age have been full fed on dry feed for 8 weeks or more.

FEEDING EXPERIMENTS.

The work in stock feeding has been with chief design of using foods which can readily be grown on almost any Oklahoma farm, using simple rations and preparing the food with as little cost as is practicable.

The station has not yet been able to provide satisfactory facilities for feeding experiments. Thus it has been found not easily practicable to determine quantities of hay, stover or other forage eaten by each animal.

Possibly in even greater degree than with experiments in crop culture, care should be taken in drawing definite conclusions from single experiments in feeding or those with small number of animals. Differences in feeding capacity of animals of like age and breeding are great in some cases. Sudden variations in the weather or some unknown cause may greatly affect results. In several trials at this station greater differences in results have been found between animals under like treatment than between selected animals with different rations.

The gains made by animals in experiment feeding are often smaller than they would be if a greater variety of food was given with occasional changes in the ration.

STEER FEEDING—1898-9.

Nine two-year-old steers were fed during winter of 1898-9, mainly to compare value of Kafir and Indian corn as grain food. With one exception these steers were of fair quality, showing considerable Shorthorn blood—except two which probably were grade Angus and Shorthorn. They had been on full feed during the previous winter, were put on pasture May 9. From this date until September they made average gain of 163 lbs., varying from 25 to 280 lbs., per steer. During September they were fed new ear corn in the pasture, making average gain of 73 lbs., each, varying from 10 to 120 lbs., each. October 1 they were brought to small pasture near stable, kept under like conditions until October 24, making average gain of only 10 lbs., each, largely because of being placed on dry feed.

October 24 they were divided into five lots, with an extra Texas steer used for inoculation experiments as second member of

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fifth pair, the other being a rough-formed steer and the purpose being to dispose of this pair as soon as practicable.

Lot 1 full feed of Kafir meal, average weight....1005 lbs.
Lot 2 full ration corn meal, average weight..... 945 lbs.
Lot 3, full ration corn and Kafir meal, half and half, average weight.... .... 990 lbs.
Lot 4 Kafir meal, approximately one pound for each 100 lbs. live weight for 10 weeks; afterwards full ration, average weight..... 930 lbs.
Lot 5 full ration corn meal, average weight..... 935 lbs.

All the steers had all they would eat of Kafir stover. It was impracticable, with the facilities at hand, to determine quantity eaten by the different animals.

The Texas steer was sold after 13 weeks feeding. After this the feed given the ninth steer is known.

While some attention was paid to color and appearance the pairs were selected with chief reference to supposed uniformity in feeding capacity. The results were surprising in some cases, the differences in the gains made by the steers in each pair being very great. There was an extreme difference of 75 lbs., in weight of the lots. The average weight of the nine steers was 964 lbs.

A summary of results by four weeks periods and whole period of 24 weeks, showing gain of each steer, of each pair, average gain for each pair per day, grain eaten and number of pounds of grain for one pound gain in live weight is given in table:

Gains and grain per pound. Gain 4 weeks periods, Oct. 24 to Apr.10.

Gains by Periods.

	Lot 1			Lot 2			Lot 3			Lot 4			Lot 5
	1	2	Av.	1	2	Av.	1	2	Av.	1	2	Av.	1
Period 1.	105	65	85	95	100	97	140	65	102	75	30	50	120
Period 2.	75	60	67	80	80	80	40	60	50	30	95	62	75
Period 3.	35	50	42	60	50	55	70	70	70	65	35	50	40
Period 4.	100	70	85	45	15	30	75	40	57	10	70	40	90
Period 5.	85	85	85	80	70	75	45	45	45	75	30	52	50
Period 6.	55	25	40	5	60	32	70	45	57	50	60	55	85

	Average Daily Gain					Pound Grain per Pound Gain.				
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Period 1.	3.00	3.48	3.66	1.87	4.30	6.58	5.74	5.67	5.35	
Period 2.	2.41	2.86	1.78	2.23	2.67	8.68	7.33	11.94	4.92	
Period 3.	1.52	1.96	2.50	1.78	1.43	15.34	11.54	9.42	8.92	
Period 4.	3.00	1.17	2.07	1.43	3.21	7.51	21.46	11.25	12.70	
Period 5.	3.00	2.67	1.60	1.87	1.78	6.75	7.90	13.30	11.16	13.20
Period 6.	1.43	1.16	2.07	1.96	3.00	14.51	18.20	10.05	12.15	7.90

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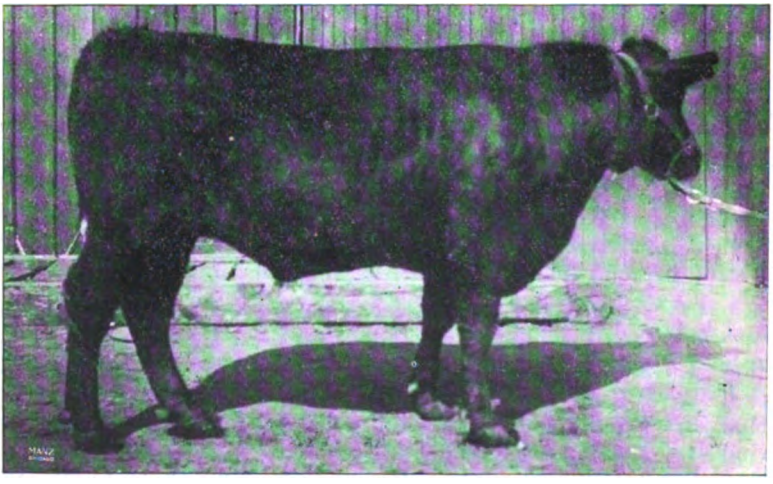
There was a difference of 100 lbs. in gain made by the two steers in Lot 1; of 115 lbs. in that made by the two in Lot 3. Those in Lots 2 and 4 made nearly the same gain. There was also much variation in the gain made from week to week. Some of these variations can be explained by changes of weather; others it is difficult to account for. No one of the steers was sick or noticeably "off feed" at any time. They were fed carefully and with regularity. During the day they had range of an open yard with Kafir stover in racks. The grain was fed in troughs in a comfortable stable.

Naturally the rate of gain declined toward the close of the feeding period as did the quantity of grain eaten. If the cattle had been fed for profit only it would have been better to have varied the ration, giving some bran or cottonseed meal and also alfalfa or some other forage with more nitrogenous matter than has Kafir stover.

The daily gain per steer in each lot is given below in two periods of 12 weeks each, except for Lot 4 which did not have full grain rations during first period:

	Lot 1.	Lot 2.	Lot 3.	Lot 4.	Lot 5.
First Period, 12 weeks	2.32 lb.	2.75 lb.	2.64 lb.		2.80 lb.
Second Period, 12 weeks	2.50 lb.	1.63 lb.	1.90 lb.	1.75 lb.	2.68 lb.

An exception to the rule is found with Lot 1 which gained more in second than in first period.



Well-formed steer, gained 455 lbs. in 24 weeks.

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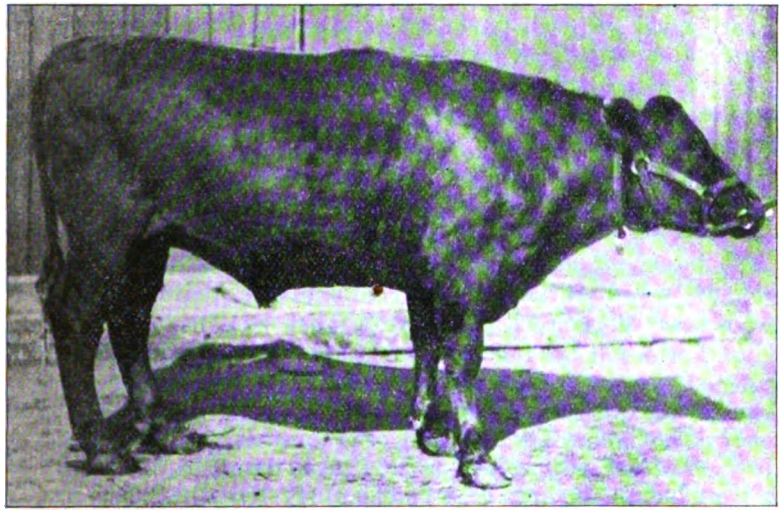

Ill-formed steer, gained 460 lbs. in 24 weeks.

One of the most interesting features of the trial is the fact that the least desirable steer in the bunch, so far as form is concerned, made a slightly larger gain than any other steer, and continued good gains during whole feeding period. The grain given him for first 13 weeks cannot be determined. During last 11 weeks he ate an average of 23.6 lbs. corn meal daily somewhat more than any

The bunch of nine fat steers.

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other steer, and made average gain of 2.73 lbs., daily, using 8.85 lbs., corn meal for each pound of gain. Snap-shot photographs of this steer and of the best formed steer in the bunch are given. The position of each is not the best. It does not follow that it is more profitable to feed ill formed steers than well formed ones. The poorer steer would not sell for as high a price as would the better one on any market. The small Texas steer fed with this inferior steer made a gain of 2.25 lbs., daily for seven weeks; but only 30 lbs., in next six weeks, at which time he was sold.

The bunch of nine steers attracted much favorable comment as unusually well fattened. They sold in the quarantine division of the Kansas City Stock Yards at $4.75.

Lot 4 was fed for ten weeks a limited grain ration, averaging 10.8 lbs., Kafir meal each per day. The average weight per steer for this period was almost exactly 1,000 lbs. They made creditable but not large gains per day, but the rate of gain in proportion to grain fed was very good, as they used but 5.51 lbs., grain for each pound gain during the whole period—less than this for first eight weeks. It is easily possible that the profit was greater from this lighter than from full grain feeding of the other lots. The relative cost of grain and rough forage, the importance of getting the animals ready for market in a given time, and other considerations must decide which course should be adopted.

STEER FEEDING, 1897-8.

Ten steers of fair quality, eight of them yearlings, two two years old, were placed on pasture May 1. From this time until September 28, they made average gain of 102 lbs., each. During October they were fed Kafir fodder on a small pasture, making average gain of 44 lbs., each.

From November 1 to December 6, five weeks, they were fed broken ear corn in troughs with cowpea hay and Kafir stover. Five steers made average gain of 103.5 lbs. or 2.95 lbs., daily. The second lot made gain of 94.4 lbs., or nearly 2.70 lbs. daily.

During week Dec. 6-13 they were stabled, accustomed to being haltered and to eating meal. For four weeks from Dec. 13 to Jan. 10, Lot 1, fed Kafir meal, averaged 102 lbs., gain, or 3.64 lbs., daily, eating a little over 7 lbs., meal for each pound gain. Lot 2, fed corn meal, made average gain of 62 lbs., or 2.21 lbs., daily, eating 10.7 lbs., meal for each pound gain.

The difference in gain was so great that it was thought advisable to change the feed of the two lots. For two weeks all were fed a mixture of corn and Kafir meal. During this time Lot 1 gained only 24 lbs., Lot 2, 54 lbs.

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From Jan. 24 to March 1, Lot 1 was fed corn meal, instead of Kafir as before, making gain of 305 lbs., average 61, lbs., or 1.69 lbs., daily eating 12.93 lbs., meal for each pound gain. Lot. 2, fed Kafir meal, made gain of 255 lbs., average 51 lbs., each, or 1.42 lbs., daily eating 17.9 lbs., meal for each pound gain. These results leave it inconclusive whether differences in gain were principally because of feed or of difference in the cattle.

STEER FEEDING, 1896-7.

Various circumstances made this work unsatisfactory. During a part of the winter satisfactory scales were not available; there were breakages of the grinding machinery making some changes of ration necessary.

Twenty young steers, part calves and part "long yearlings," not very uniform in character were fed in five lots of four each. One lot was fed in racks and troughs in a well protected yard; the other four lots were fed in large box stalls, too small for greatest comfort of the animals. During the day they had access to a large lot. The average weight of the steers in the several lots, Oct. 15, when the preliminary feeding began, was: Lot 1, 715; Lot 2, 760; Lot 3, 605; Lot 4, 545; Lot 5, 450 lbs.

The gains during the preliminary period varied much: Lot 1, 25; Lot 2, 265; Lot 3, 165; Lot 4, 150; Lot 5, 236 lbs. This inequality did not continue in so marked a degree.

In the eight weeks from Oct. 31 to Dec. 26 there was some variation in the feeding—shelled corn being fed for three days at the last and no cottonseed given for last five days. The table shows results as to each lot.

	Gain.	Corn Meal.	Cotton Seed	Grain per lb. gain	Gain per day
Lot 1.	595	2476	1761	6.14	2.63
Lot 2.	610	2456	1140	5.09	2.72
Lot 3.	520	4115		7.91	2.32
Lot 4.	455	2026	1033	6.72	2.03
Lot 5.	495	2400	355	5.56	2.22

While accuracy of the scales used was not absolute it is believed there was no material error from this source. The rate of gain is good and the gain per pound of grain very good. The lot having corn meal only used more grain for each pound of gain than either of the others. The lot having only small quantity of cottonseed made next to best showing.

During four weeks from Dec. 26 to Jan. 23 all the steers were fed shelled corn as exclusive grain food, except that, by mistake, about seven pounds of cottonseed for each steer was fed during last few days of the period. This counted as corn in total feed.

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	Gain lb.	Shelled Corn.	Lbs. Grain per lb. gain	Grain p r Dav.
Lot 1.	320	2228	6.81	2.85
Lot 2.	190	2268	11.93	1.69
Lot 3.	295	2128	7.21	2.63
Lot 4.	260	1736	6.61	2.32
Lot 5.	245	1732	7.06	2.18

The showing is a good one except for Lot 2. No explanation can be given for the small gain made by this lot.

For the five weeks, Feb. 13 to March 20, Lots 1 and 2 were fed corn; Lot 5, younger and lighter steers corn and bran. Neither lot made large gains, ranging from 1.28 to 1.37 lbs., per day, but Lot 5 used but 10.53 lbs., grain for each pound gain, while the others used over 13 lbs., for each pound of gain.

For the 23 weeks, Oct. 31 to April 10, the daily gain per steer per day was: Lot 1, 2.19; Lot 2, 1.63; Lot 3, 1.84; Lot 4, 1.67; Lot 5, 1.78. For the three weeks following, up to May 1 the rate of gain of all the lots was unsatisfactory, probably because of warmer weather and the practical necessity of letting the steers have access to a small pasture affording enough grass to unfavorably affect their appetite for dry food.

EFFECT OF DEHORNING.

Eleven of these 20 steers were dehorned Nov. 11. Three days afterwards these eleven showed average loss in weight of 11 pounds in weight, while those not dehorned showed average gain of 15 pounds. One week later the recently dehorned steers showed average gain of 30 lbs., the other nine of 21 lbs., thus showing an apparent average loss of 17 lbs., from dehorning. No one of the dehorned steers was "off feed" at any time.

FEEDING COTTON SEED.

No injury has been found from feeding cotton seed to any class of cattle, although it has not been fed to young calves. In the case in which it has been the sole grain food the gains have not been satisfactory. Feeding moderate quantities, say four pounds per day per steer in connection with corn or Kafir has given satisfactory results. Great differences have been noted in the readiness with which different steers ate the seed, some not seeming to like it at any time if they had access to grain.

GAINS ON PASTURE.

The rapid improvement in appearance and in weight of cattle in thin flesh when turned on good pasture has led many to over estimate average gains. Oklahoma native grasses are palatable

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and nutritious. With favorable weather the "short grass region" keeps cattle in fair health throughout the winter. But flies and hot weather come early in the season and tend to retard growth. If there be summer drouth there is little gain.

In no case have the gains on good upland prairie pasture on the station farm been large for any long period. Partly this is to be explained by the fact that in all cases the station cattle were in good flesh when put on pasture. The gains made by different lots of steers during the summer are given above.

May 1, 1899 a small bunch of cattle were put on pasture. Up to June 14, 55 days, they had made gains as follows: Jersey bull 90 lbs.; yearling steer, fat, 50 lbs.; two young cows 35 lbs.; two calves 65 lbs.

At suggestion of Board of Regents two well fattened two year old steers, ready for market, were placed on pasture. They made less gains than yearlings; as they did when fed through the next winter. Oklahoma may not be ready to produce "baby beef," profitably, but it is better to sell fat native two year olds rather than keep them for another year.

A supply of green food, corn, sorghum, Kafir, alfalfa or cowpeas with which to supplement the pastures in August and September is desirable.

VARIATION IN GAIN.

A half-Jersey steer, about one year old was fed during the winter of 1898-9, showing remarkable variations in gains in equal periods. For first four weeks, although not "off feed" at any time, he gained only 10 lbs., eating 282 lbs. Kafir meal and 114 lbs., cotton seed. For next four weeks the gain was 60 lbs., with 408 lbs. Kafir; next 65 lbs., next 35 lbs., with 448 lbs., Kafir in each period.

A young cow made gain of 115 lbs., in four weeks, 95 lbs. in second, 110 lbs., in third period of same length, and then fell to gain of 10 lbs. in next two weeks, at which time she was sold.

PIGS ON PASTURE.

April 27, 1899 eight pigs were divided into two lots, one weighing 250 lbs., the other 270 lbs. They were placed in alfalfa plats of about one-half acre each, one lot receiving no other food, the other full feed of Kafir meal or shelled corn.

During five weeks the pigs with no food but alfalfa made gain of 61 lbs., or 15.25 lbs., each. For next three weeks, to June 22nd, they gained only seven pounds, less than two pounds each. While there was a good stand of alfalfa and the season was favorable for its growth, the four pigs, averaging about 80 lbs., each kept it well eaten off.

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The four pigs full fed grain with the alfalfa gained 199 lbs., in five weeks, or practically 50 lbs., each in 35 days. In next three weeks they gained 125 lbs., or nearly one and one half pounds per day.

With this last was a sow with a litter of pigs. She gained 61 lbs., in first five weeks, when she was removed, her five pigs gained 146 lbs., in first five weeks and 96 lbs., in next three weeks. A young boar in same lot gained 46 lbs., in 26 days, and 29 lbs., in next three weeks.

There was fed to all the pigs in this plat 1688 lbs., corn and Kafir. They made total gain in eight weeks of 764 lbs., using only 2.21 lbs. grain, in addition to the alfalfa for each pound of gain. Counting the small pigs with the others the grain eaten was less than three pounds per day each.

Obviously the grain feeding was profitable. Possibly equal or greater profit might have resulted if only partial feed of grain had been given.

The plat pasturing the pigs with grain feed carried at least one-half more stock than the other, but the alfalfa remained green and fresh.

Six young brood sows, with pigs, were kept during same period on a small native grass pasture with access to a very small quantity of the droppings and waste from feeding the work teams. They gained 50 lbs., in five weeks, and 90 lbs., in next three weeks. The sow which had been full fed grain on alfalfa pasture during May, was put in this pasture June 1 and lost 11 lbs., in three weeks. This trial illustrates the fact that our native grasses will enable pigs to make some gain during the early part of the season. They become less palatable as the season advances.

WEIGHT AND GAIN OF YOUNG PIGS.

At different times the weights of litters of pigs have been taken weekly. In no case had the pigs more than ordinary care and no great gains have been recorded.

The average weight at birth of litters from sows of different breeds was: 2.44 lbs., 3.05 lbs., 2.6 lbs., 2.25 lbs., 2.43 lbs., 2.7 lbs., 2.77 lbs., 2.75 lbs., 3.07 lbs., each; general average 2.65 lbs.

The weights of six litters at seven days old were: 4.25 lbs., 5.3 lbs., 4.6 lbs., 5 lbs., 5.6 lbs., 4.05 lbs., each; general average 4.8 lbs.

The weights of nine litters at 28 days were: 13 lbs., 13 lbs., 11 lbs., 13.8 lbs., 8 lbs., 11 lbs., 13 lbs., 13.8 lbs., 12 lbs., each; general average 12.1 lbs.

The average weights of nine litters at 56 days were: 32 lbs.,

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21.7 lbs., 23.3 lbs., 23.75 lbs., 22 lbs., 24 lbs., 23.8 lbs., 25.2 lbs., 18.4 lbs., each; general average 23.8 lbs.

In nearly all cases the typical "runt" was found in each litter.

A case of unusually rapid gain in hog feeding was that of a mature high grade Duroc-Jersey sow, thin in flesh from suckling pigs. For the six weeks from Jan. 16 to Feb. 27, 1899 she made gain of 135 lbs., a little over three pounds per day, being fed 708 lbs. Kafir meal, or 16.85 lbs., per day, using 5.24 lbs., meal for each pound gain. Not all of this was eaten as more than usual waste occurred. In next four weeks she made gain of 60 lbs., as did smaller sow put in pen with her, or 2.14 lbs., each per day, using 5.73 lbs., meal for each pound gain.

GAIN OF PIGS FOLLOWING CATTLE.

The gain made by hogs getting the waste food from cattle is much less when the cattle are fed meal instead of ear or shelled corn or unground Kafir. Five pigs having access to droppings of a lot of steers full fed on corn and Kafir meal gained only 195 lbs., in 56 days or 39 lbs., each. In another case five pigs gained 100 lbs., in 56 days. In a third case six moderate sized sows gained 245 lbs., in 56 days, a little less than three-fourths of a pound each per day. While these gains are small they are worth saving. The difference between profit and loss in feeding cattle often depends on the use made of the food wasted or undigested by them.

COMPARISONS OF CORN AND KAFIR.

Six pigs averaging about 135 lbs., weight at beginning of trials ate 2,482 lbs. Kafir heads in six weeks, making 280 lbs., grain, or 1.11 lbs. each per day. This is one pound gain for about 6.65 lbs. grain.

Three pigs averaging 220 lbs., ate 728 lbs. corn and Kafir meal in 24 days, making gain of 130 lbs., or 1.8 lbs. per day each, using 5.6 lbs., meal for one pound of gain.

Two young sows, averaging 125 lbs., ate 640 lbs. ear corn in 35 days, making gain of 107 lbs., or 1.53 lbs. per day each. Counting the ear corn equal to 529 lbs., shelled corn they used 4.94 lbs., corn for each pound gain. In the next two weeks they ate 258 lbs., Kafir meal, gaining 28 lbs. or one pound per day each, using 9.21 lbs., meal for each pound of gain. This is the least satisfactory gain made in any trial where Kafir was fed.

Four pigs averaging 105 lbs., ate 987 lbs., Kafir meal in 35 days, gaining 170 lbs., or 1.21 lbs., per day, using 5.08 lbs., meal for each pound gain. In next two weeks they ate 212 lbs., shelled corn, soaked, gaining only 30 lbs., using 7.07 lbs., corn for each

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pound. For next four weeks to June 26, 1899, they were fed soaked shelled corn with a daily supply of green alfalfa. Noticeable increase in gain resulted. They ate 511 lbs., corn, making gain of 140 lbs., using 3.65 lbs., corn for each pound gain. This is a striking illustration of value of alfalfa in connection with grain feeding in summer.

Four pigs averaging 170 lbs., ate 685 lbs., corn meal and 300 lbs. ground wheat of poor quality in 30 days, gaining 181 lbs., or 1.5 lbs. per day each, using 5.44 lbs., meal for each pound gain.

FATTENING PIGS ON FORAGE CROPS.

August 23, 1898, nine pigs belonging to the same litter except one, were put in a pen and fed ear corn preparatory to feeding forage crops. The pigs were farrowed February 28, 1898, weaned at about two months old, put on pasture for the summer and fed some corn meal to keep them growing. They were divided into three lots each, containing three pigs. They were fed the same kind of grain, ear corn until October 17, corn meal from October 17 to 24 and Kafir meal from October 24 until December 5.

Until October 10 the pigs were in permanent pens and the forage was cut green and carried to them. From this date the pigs were in movable pens where they could harvest the crops themselves.

PIGS FED ON GRAIN AND FORAGE CROPS.

	Weight of Lot		Gain of Lot		Feed	
	First	Last		Daily	Forage	Grain per Lb Gain
Period I. Six Weeks.						
Lot 1	195	327	132	3.14	Sugar Beets 1-22 a	3.47
Lot 2	200	340	140	3.33	Cowpeas 1-20 a	4 55
Lot 3	195	259	64	1.52	Sorgum 1-26 a	8 94
Period II.— Five Weeks.						
Lot 1	327	420	93	2.66	S. Potatoes 1-18 a	4.75
Lot 2	340	447	107	3.03	Peanuts 1-15 a	4.29
Lot 3	259	327	68	1.66	Cowpeas 1-9 a	6.75
Period III.— Weeks.						
Lot 1	420	475	55	2.62	S. Potatoes 1-30 a	6 07
Lot 2	447	503	56	2.66	Peanuts 1 25 a	5.96
Lot 3	327	293	66	3.14	Peanuts 1-18 a	5 05

The gain per day was small in all cases. Striking differences in apparent value of the different forage crops are shown.

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FARM TEAM WORK, FOOD, DRINK, COST.

A pair of mules are kept on the station farm doing all kinds of farm work. They are eight or nine years old and have weighed from 1980 pounds during the busiest part of the season to 2240 pounds in the winter. They are kept on dry feed throughout the year.

During the year 1898 the team worked 2148.5 hours, an average of a trifle more than 7 hours a day for each work day. They were fed 41 bushels of Kafir corn, 73 bushels of Indian corn, 43½ bushels of oats and 455 pounds of bran. Kafir or Indian corn stover was fed about six months of the year and alfalfa and prairie hay the remainder of the year.

The Kafir was fed ground and the Indian corn in the ear. Counting Kafir 20 cents per bushel ground, Indian corn 20 cents per bushel in the ear, oats 25 cents per bushel and bran 60 cents per hundred, the cost of the grain fed to the team was $36.40.

During December the amount of Kafir stover fed was about 1400 pounds. Estimating that there were four tons of stover worth $2 per ton and four and one-half tons of hay worth $4 per ton fed during the year, the cost of roughage would be $26, making a total cost of feed for the year of about $62. This is 17 cents per day and about three cents as cost per hour for food.

The food and water used by this pair of mules and a pair of horses used on the station farm was noted for two weeks during the spring of 1899. Each pair averaged about 2130 lbs. weight. They were at moderate work except on Sundays and one or two rainy days. The horses had an average of 30.6 lbs. ear corn, and 31.6 lbs. of Kafir stover, and drank 107 lbs. water per day. The mules had 23.4 lbs. ear corn, 40.5 lbs. stover and drank 107 lbs. water per day. The mules did about one-third more work than the horses, ate less corn, more stover and drank more water. Not all the stover was eaten by either pair. There were marked variations in the quantity of water drank. One mule averaged nine pounds daily more than the other; one horse five pounds. Temperature much affected the quantity drank. Each of the horses and one mule drank 100 lbs. or more of water in one day. When idle the quantity fell as low as 18 to 20 lbs. per day in three cases.

In a time of hot weather in August, 1898, the water fed to the pair of mules was weighed for eight days. They were idle two of these days, reducing the average working time to less than seven hours per day. They drank an average of nearly 113 lbs. each of water daily. One day the pair drank 350 lbs.; another 307 lbs. In three of the five days they averaged less than 100 lbs. water each.

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SHEEP FEEDING.

Sixteen grade Shropshire wether lambs were fed Kafir heads, with prairie grass hay and corn stover for 13 weeks in winter of 1898. They kept in good condition but made small gains—295 pounds or a trifle over one-fifth of a pound per day. They ate 1624 lbs., Kafir heads. A wether lamb made gain of 13 lbs., in four weeks, or .46 lb., per day. A Shropshire ram lamb gained 17 lbs., in same time or .6 lb., per day. They ate two pounds Kafir meal each day, with "crab grass" hay.

The wether lamb and three rather inferior yearling wethers which had been used in digestion experiments, made gain of 86.5 lbs., in 52 days or .41 lb. per day each. They ate 504 lbs., Kafir grain, using 5.82 lbs., for each pound gain.

WEIGHT OF LAMBS.

The table gives weights of lambs at ages specified. They were dropped from March 16 to April 30, 1899. The weights of two pairs of twins and of two single lambs are given. They are pure bred or high grade Shropshire.

Age	No. Lbs.		Age	No. Lbs.		Age	No. Lbs	Age	No. Lbs.
Birth	10	10	Birth	7	7	Birth	9	Birth	9
7	14	13	7	11	11	7	14	7	13
14	18	17	14	15	13	15	19	14	20
21	22	20	21	19	17	23	24	22	22
28	27	25	29	25	20	30	30	29	25
35	32	29	36	31	22	37	35	36	30
42	35	33	43	33	25	44	40	43	40
49	40	38	50	33	28	51	42	50	45
56	43	41	57	37	31	58	49	57	49
63	49	43	64	42	33	65	53	64	53
70	55	48	71	45	37				
77	59	51							
84	65	54							
91	67	60							
98	70	72							

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WHEAT CULTURE EXPERIMENTS—1898-9.

G. E. Morrow and J. H. Bone.

The tests were made, as in previous years, on the medium upland prairie soil of the station farm—the same tracts being used as in 1897-8. The land on which the variety tests were conducted had been manured in the winter of 1895, and had the roots and stubble of a crop of cowpeas plowed under in September 1898. Except where otherwise stated the other experiment plats had been manured in summer of 1898 at rate of about 16 tons coarse stable manure per acre.

Varieties. Thirteen varieties, with one or two exceptions grown on the farm for the last four years were used in the variety test, having been selected from a much larger list as being most promising. The seed used was that of the crop of 1898 and was of light weight. All the plats were sown at rate of five pecks per acre, Sept, 19 or Sept. 21, except Turkey which was sown Sept. 29. The land was plowed Sept. 10 after a crop of cowpeas, following wheat had been removed. The seeding was done with a press drill, rows six inches apart. The wheat came up well in six days. The first heads appeared from May 7 to 11. The wheat was cut June 12—except Turkey. The wheat was thrashed June 22.

Three plats each of Fulcaster and Red Russian were sown as check plats. There was a difference of four bushels in yields of these plats, the average yield of the three of Fulcaster was 25.8 bu., the Red Russian, 23.3 bu. These averages are taken for these two varieties.

The average yield of the 13 varieties was 22.6 bu. Only the Turkey yielded less than 20 bu. per acre. The five varieties giving largest yields were: German Emperor, Fulcaster, Sibley's New Golden, Red Russian and Early Ripe. The average weight per bushel was about 59 lb., varying from 58 lb. to 60 lb. The straw varied in height from 38 to 43 inches, and as cut, from 1870 to 3333 lb. per acre. All varieties stood up well.

The yields of the different varieties, yields of straw per acre, also the average yields for last four years for the varieties tested during this time are given in table.

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Yields	Bu. Grain 1899.	Lbs. Straw 1899	Bu. Grain 1896-1899
German Emperor	27.9	3,333	28.6
Sibley's New Golden	27.2	2,332	30.7
Fulcaster	25.8	2,339	27.7
Early Ripe	23.8	2,365	26.9
Red Russian	23.3	2,416	27.3
New Red Wonder	23.1	1,969	....
Nigger	22.9	2,365	29.8
Fultz	22.9	2,035	26.6
Mo. Blue Stem	21.1	2,100	30.3
Early Red Clawson	21.1	1,870	29.1
Pickaway	20.3	2,079	28.4
Big English	20.	2,101	28.8
Turkey	14.7	1,738	....
Average	22.8	2,334	28.5

The best yielding varieties for the last four years are: Sibley's New Golden, 30.7 bu.; Mo. Blue Stem, 30.3 bu.; Nigger, 29.8 bu.; Early Red Clawson, 29.1 bu.; Big English, 28.8 bu.; German Emperor, 28.6 bu. Fultz and Early Ripe are the only ones in the list with an average yield of less than 27 bu.

The variety called Turkey or Red Turkey has been highly praised but the results were not satisfactory. In addition to the plat in the variety test two other plats were sown on one of the rotation plats, sown Oct. 1. One was sown with seed obtained in the vicinity; one with seed from the U. S. Department of Agriculture. The latter gave yield of 20.5 bu., the other only 13 bu., a difference hard to be accounted for.

TIME, QUANTITY AND METHOD IN SOWING.

The series of experiments tried in former years was repeated. Thirty-two plats were sown with Red Russian wheat at intervals between Sept. 1 to Nov. 15; the quantity of seed varying from three to eight pecks per acre, some of the plats being rolled before sowing in addition to being harrowed.

The superiority of early sowing was shown in an unusual degree. In some years good crops have been obtained from sowing late in November but late sowing in fall of 1898 was invariably unsatisfactory. No marked differences were found from sowing at four dates in September, and fair yields were secured from sowing Oct. 5. With one exception no plat sown after this date gave yield of more than 12.5 bu. and most were much below this.

The marked decrease in yield and in quality of the wheat from later sowing is shown in following summary: Twelve plats sown in September gave average yield of 28.7 bu., with average weight

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of 58.5 lb. per bu. Eight plats sown Oct. 5 and Oct. 15 gave average yield of 21.5 bu., with average of about 55 lb. per bu. Twelve plats sown in November gave average yield of 5.4 bu., with average of about 45 lb. per bu.

As a whole rolling somewhat increased the yields but not in any marked degree.

The largest yield was from plat sown with five pecks per acre. In no cases did the yields from sowing three or four pecks equal those from sowing five or six pecks. In the later sowings eight pecks gave largest yields, as might be anticipated as the late sown wheat does not stool so readily.

Four plats were sown with Fulcaster wheat, the seed varying as follows: One plat seed of full weight from exceptionally good crop of 1897; the others with seed from crop of 1898, one plat being sown with the largest kernels; one with second grade kernels and one with the wheat as it came from the thrasher. There was little difference in the yields; that from the seed of 1897 crop being slightly smallest. The second grade kernels gave same yield as the first grade.

TIME AND METHOD OF PLOWING—MANURE AND NO MANURE.

Six plats, wheat stubble were plowed July 29; two each at following depths: 4 in., 8 in., 8 in., and subsoiled to 15 in. Three were manured with stable manure; three left unmanured. Plowing 4 in. deep gave somewhat smaller yields than deeper plowing. No gain came from subsoiling over plowing 8 in. In each case manuring greatly increased the yields. Two plats were plowed 8 in. deep Sept. 3, one manured, one not. The yields were noticeably smaller than from earlier plowing, the two yielding an average of 16.8 bu., while the two plowed at same depth in July gave average yield of 23.1 bu.

The four manured plats gave average yields of 27.5 bu., the unmanured 14.5 bu.

An equally striking illustration of the value of manuring was shown in the case of yields on two half-acre plats devoted to continuous culture with wheat. Wheat has been grown on both plats for seven years. In fall of 1898 one half acre was manured with about 15 tons per acre. All other treatment was as nearly the same as was practicable. The manured plat gave yield at rate of 30.6 bu., the unmanured 12 bu. per acre. Manuring here increased the yield two and one-half times.

Two plats lying side by side were manured, one with stable manure, the other by turning under the stubble and roots of a moderate crop of cowpeas. The former gave 23.2 bu., the latter

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16.3 bu. per acre. The yields in both cases were unexpectedly small but the gain from stable manure was marked.

Fifty-eight plats, including a number purposely sown to illustrate loss from late plowing or other undesirable practices, and excluding only the late sown plats, gave an average yield of 22.67 bu. per acre. This is about ten bu. above the average yield of wheat in the United States in a series of years.

All experience at this station emphasises the importance of increasing the supply of decaying vegetable matter in our upland prairie soils. It is believed the gain comes more from improving the physicial condition of the soil and its relations to moisture than from the addition of direct plant food in the manure.

The results of this year's trials confirm the conclusions that, with reasonable management, wheat culture is profitable on Oklahoma prairie soils; that no one variety has been found greatly superior to all others; that five pecks per acre is a safe quantity to sow per acre and that sowing in September is safer than at any later time, aside from the valuable pasturage secured from early sown wheat.

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DESTRUCTION OF INSECTS.

A part of the duties of the station entomologist is to answer inquiries in regard to the name, nature and methods of destroying injurious species of insects. It is a part of his business to keep posted on the various methods that are being tried for the destruction of insects and at the same time make original investigations. The station is ready at all times to furnish information on the latest and most practical methods of insect destruction. It is often the case, however, that from the nature of the insect, it is impossible to recommend any method whereby an insect may be destroyed and at the same time preserve the substance on which it feeds; the grain louse for example.

The station has no mysterious means to be employed against insect ravages and it is often the case that the best thing that can be done is to turn to some common means that nearly everyone has at hand or may have at a minimum of expense and trouble. It is advisable to read catalogs of insecticides and spraying apparatus which if intelligently used often save many times their cost. It often happens that an insect appears without any previous warning and although a man might be disposed to purchase insecticides and apparatus, before he could get such things half way home his crop might be devoured and he would have to wait for another crop and another horde of insects before his apparatus would yield any returns.

The old saying that procrastination is the thief of time was never more applicable than in the destruction of injurious insects. A single instance will illustrate. A grape grower in the territory discovered the rose chafer coming from a grass field onto one corner of his vineyard. They came in numbers sufficient to have done considerable damage. He immediately had them picked off the vines by hand twice a day for several days or as long as they continued to come and thereby saved his vines with but little damage. This shows that one should exercise vigilance and watch over what he is trying to grow.

Fowls of all kinds destroy many insects. We have in the territory a thick, heavy beetle commonly called June bug or peach eater. In regions where figs are grown it is called the fig eater. It is on hand when the Alexander and other early peaches are ripening and attacks the best specimens sometimes eating every-

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thing but the stone which it leaves hanging on the tree. Poisoning it is out of the question. Hand picking would be tedious. Putting a paper sack over each peach would be too expensive. One farmer in the territory noticed that the beetle is dull and stupid in the very early morning. He trained his flock of turkeys to follow him to the trees in the early morning where he with a pole would jar the beetles off the trees and they would pick them up. They soon even learned to do their own shaking and picking so that the farmer could take his morning nap while the good work was going merrily on.

One of the best animal friends the Oklahoma farmer has is the little horned toad. He thrives, like the insects on which he feeds, in dry weather when the crops are almost at a standstill. An investigation showed that the stomach of one specimen contained 235 chinch bugs besides several caterpillars and other insects.

There are often sent to the station eggs closely stuck together into a mass about five-eighths of an inch long and half as high of a grayish color.. These are the egg masses of the "praying mantis" or "devil's rear horse," an insect that has an ugly appearance and should be let alone as the only prayer it offers is for more insects such as plant lice to devour. The egg masses are often found on the branches and twigs of fruit trees and too often, through ignorance of their nature, destroyed.

The station often receives specimens of brown scale-like objects arranged on a twig in one or two rows close together and so that one overlaps the next about half way. They somewhat resemble broad flax seeds. They are the eggs of the common katydid and will do but little harm. They are often suspected to be the San Jose Scale but each one is about twenty times as large as a scale of this kind.

E. E. BOGUE.

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DISEASE AMONG HORSES.

In the early part of September, 1898, numerous inquiries reached the Experiment Station regarding a very fatal disease among the horses in Kingfisher, Garfield and Grant counties. Soon after the first inquiries were received, the disease assumed the form of an epidemic extending to a considerable portion of the counties named and to a less extent into Woods, Kay and Blaine counties.

The first appearance of the disease was reported from Sheridan in the eastern part of Kingfisher county. The first deaths occurred about September 1, and for a time the disease in Kingfisher county appeared to be confined to this locality and on bottom pastures, but by September 10th animals were dying on upland pastures over a considerable area of country. There is in the section of country where the disease was most prevalent very little low land or timber, the greater portion of the country being a high, level prairie with very little low land along the streams.

Two visits were made to this part of Oklahoma in September. The first locality visited was Sheridan where the disease was first reported and it was found to be present over that portion of the county between Sheridan and Hennessey, a large number of farmers having lost stock or had sick animals at the time.

It was a very noticeable fact from the beginning of my inquiries that the disease was confined to farm animals. On making inquiries among the liverymen and other stock owners of Hennessey, Enid and Waukomis, I found they had not lost any horses from the disease, although their feed, and hay especially, was purchased from the surrounding country. This led to a close examination of the pastures where the disease was most prevalent. The principal grass of a large part of western Oklahoma is Grama grass (*Bouteloua oligostachya*) which makes a valuable pasture. In a large number of pastures examined the seed of the grass was largely replaced by smut (*Ustilago bouteloуae*). It was so abundant that after a light rain the grass would be colored black with the smut. This smut was present in large quantities in all pastures examined where the Grama grass was found. It was also noticed that in pastures closely grazed there was no disease as the grass did not mature seed. As the Grama grass was replaced by other grasses in the northern part of Garfield county the disease disappeared, but from all information the disease was prevalent in the southern part of Grant county.

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No other cause could be assigned for the disease except the excessive quantity of smut found on the grass as no losses occurred where the smut was not found or among horses that were not pastured. There is a small amount of smut present every season, but when it exists in such quantities as found last season, stock should not be allowed to graze on the pastures until they have been mowed and the grass tops destroyed, or until late in the season after heavy rains have washed out the smut.

Where opportunity offered, treatment was tried using large doses of potassium bromide and chloral, using atropine when indicated and applying cold packs to the head. This treatment was successful in many cases, but usually the disease assumed a very acute form giving little opportunity for treatment.

In many cases the animal would not live longer than six to twelve hours after the first symptoms, but animals were seen that had been sick from three to six days.

Partial paralysis of some parts of the body was usually noticeable; seen most frequently in the hind limbs and where the disease continued for several days this would become so complete that the animal would be unable to rise. Only one sick animal was seen that was violent and very few cases were reported. The most common course of the symptoms was a staggering gait at first; the animal if left alone would walk in a circle or would stand with head drooped or pushed against the wall of the stall or manger. When unable to stand longer, they remained lying quietly allowing the head or feet to remain in any position in which they were placed. In one violent case seen, the animal was unable to stand and spasms followed every few minutes lasting for a few seconds. This continued for about an hour when the animal died. In an adjoining stall was another sick animal lying perfectly quietly, apparently sleeping most of the time and would allow the head or feet to remain in any position. Breathing was very slow and stertorious.

Three postmortem examinations were made. The internal organs of all were fully examined but no variation from normal noticed. The only changes found were in the brain and medulla. In two cases examined, the base and coverings of the brain were congested and a small quantity of bloody serum surrounded the brain. In the third postmortem, the membranes of the brain were congested with a small amount of serum present around the brain and the medulla.

The symptoms and postmortem examinations all indicate that the disease was inflammation of the brain and its covering, or cerebro-spinal meningitis.

L. L. LEWIS.

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CLIMATIC CONDITIONS OF OKLAHOMA.

The class of farming to be selected in different portions of Oklahoma depends more on the annual rainfall and its distribution than on soil or other conditions, unless market facilities be an exception. There is poor soil in the territory but the great mass of the soil of Oklahoma is at least fairly fertile, given a sufficient supply of moisture. Hot winds sometimes cause much loss to crops, but these would be much less severe if the soil had abundance of water. Bottom or irrigated lands suffer relatively little from such winds.

The meteorological conditions have been studied long enough to make it safe to form some general conclusions, although there are considerable differences in the rainfall between series of years as well as between different years in any series. The distribution of the rainfall through the year is almost as important as is the total for the year.

Under the direction of army officers, the rainfall and temperature records have been kept at several forts in Oklahoma and the Indian Territory for a period longer than that since the opening of Oklahoma to settlement. Since 1890 the U. S. Weather Bureau has had a central observing point at Oklahoma City, to which reports are made from a considerable number of points by voluntary observers. The records at the experiment station are not complete prior to May, 1895.

As in the states north and south of Oklahoma, the rule is that the rainfall decreases from east to west and with increased elevation. The evidence is conclusive that eastern Oklahoma has sufficient rainfall so distributed throughout the year to make the cultivation of most ordinary farm crops reasonably safe, except on high, sloping uplands. It is equally well settled that western Oklahoma is best adapted for grazing purposes, that the soil there had best be left in the natural grass crop, unless irrigation is practicable, or in case of some creek or river bottom land.

There is a middle section, the boundary lines of which cannot be exactly stated, the fitness or unfitness of which for farm crops cannot be stated with equal positiveness. In this section there is most danger of settlers making costly mistakes. The experience of farmers in Texas, Kansas, Nebraska and the Dakotas may be studied with profit. There is no good reason for expecting any marked variation in the average rainfall in regions with same longitude and elevation north or south of Oklahoma.

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Of cultivated grain crops Kafir and sorghum are safer for uplands in the eastern part of the territory and for all lands not irrigated west of 98 deg. Wheat will do well with much less rain than is necessary for corn, as it does not continue its growth through the extremely hot weather. Cotton is quite as subject to injury from excessive rains or wet weather as from moderate drouth. Alfalfa is a safer crop than any of the true clovers or the grasses usually cultivated further north and east. Bermuda grass thrives well in the eastern half of the territory, at least. Bromus inermis and the so called English blue grass give promise of fair success. Orchard grass seems to offer better promise than timothy, redtop, blue grass, etc. The millets do well generally. Cowpeas, soy beans, pea nuts, sweet potatos, melons and turnips often produce large crops with comparatively little cultivation.

Fruit trees make a phenomenally rapid growth in eastern Oklahoma. The indications are that much of Oklahoma will prove to be well adapted for growth of apples, peaches, plums, grapes, blackberries and reasonably well suited for strawberry culture.

METEOROLOGICAL TABLES.

Tables giving summaries as to temperature and rainfall at this station so far as the records are complete and at several points in the territory for a considerable number of years are given. The latter were prepared by J. I. Widmeyer, Section Director at Oklahoma City for the Climate and Crop Service of the U. S. Weather Bureau. In some cases the records are not complete.

Temperature. The mean annual temperature for the southern part of the territory is about 59 deg. F. A record of 100 deg. or more may be expected in most parts of the territory at some time every year—from June to September. In 1898 the hottest days were in the early part of October. Zero or a little below is indicated almost every winter in the northern part of the territory. The coldest weather recorded was that of February 11-12, 1899, at which time the thermometer showed from —15 to —25 deg.; at this Station —17 deg. The relatively low humidity makes the high temperature less oppressive.

Rainfall. The average annual rainfall east of 97 deg. 30 min. Long. is probably fully 31 inches for Oklahoma proper. In the Indian Territory it is much greater. The average west of this parallel is less than 30 inches; probably not more than 28 inches.

Especially in the summer there are occasional excessively heavy rains which make a good showing in total for year but are much less desirable than more frequent moderate rains. The heaviest rainfall is usually in May, June and July; often good rains in March and April. The lightest rainfalls are in the winter months,

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or from October to February inclusive, except that December usually has more rain than either of the other months in this period.

There are great variations in the rainfall of different years. The years 1892 and 1898 had heaviest rainfall since the opening of the territory. The years 1894 and 1896 had less than the usual rainfall. The rainfall at this station in 1898 was about 11 inches more than in 1897; at Oklahoma City over seven inches less, at Fort Sill 11 less; at Mangum 8.5 less.

Winds. The prevailing winds are from the south. In 1898 the average velocity at Oklahoma City was 10.6 miles per hour; greatest velocity in March and least in August.

Frosts. In 1897 the last "killing frost" reported varied from March 23 to April 16; in 1898, from April 6 to April 14, except at Ft. Reno where frost was reported May 2. The first fall "killing frost" in 1897 occurred from Oct. 29 to Nov. 2; in 1898 from Oct. 16 to Oct. 22, except at Waukomis where frost was not reported until Oct. 28.

MONTHLY AND ANNUAL MEAN TEMPERATURES.

OKLAHOMA CITY.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1891..	37.8	39.2	43.6	60.8	64.4	74.3	76.2	76.8	72.4	60.8	47.0	44.4	58 1
1892..	33.0	44.2	44.6	59.2	65.2	75.1	79.0	77.0	72.4	62.0	48.0	35.6	58.0
1893..	37.6	35.8	50.2	62.4	65.4	76.2	81.2	75.2	74.4	61.7	45.4	43.7	59.1
1894..	36.8	34.8	52.6	62.9	68.2	75.4	79.4	78.4	74.4	64.0	49.8	41.6	59.9
1895..	33.2	29.5	50.0	63.1	69.3	76.8	78.3	79.1	76.1	65.7	45.0	38.4	57.9
1896..	39.4	43.4	46.4	66.1	73.3	76.2	80.7	83.2	71.9	59.2	46.6	45.0	61.0
1897..	34.8	42.1	50.4	59.6	65.8	75.4	80.8	78.4	75.2	66.0	48.6	35.6	59.4
1898..	40.4	44.1	49.4	57.8	68.2	76.8	78.3	78.2	74.1	60.1	46.0	35.1	59.0
Average	36.6	39.1	48.4	61.5	67.6	75.8	79.2	78.3	73.9	61.2	47.0	39.9	59.0

STILLWATER, OKLAHOMA.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1895..	....	....	....	....	69.0	77.0	78.4	79.7	75.9	64.9	45.9	38.0	....
1896..	39.5	43.7	46.3	66.3	73.9	74.7	80.0	82.7	72.0	59.2	46.6	43.4	60.7
1897..	33.7	41.4	51.0	58.0	65.4	75.7	81.1	77.3	74.1	64.6	47.0	32.1	58.4
1898..	37.9	43.5	49.8	58.3	64.5	76.9	78.9	77.8	74.5	60.2	46.0	36.0	58.6
Average	37.0	42.9	49.0	61.9	68.2	76.1	79.6	74.4	74.1	59.7	46.4	37.4	59.2

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TOTAL MONTHLY AND ANNUAL PRECIPITATION.

OKLAHOMA CITY.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1891..	2.48	0.44	3.04	4.80	5.92	4.73	6.17	0.79	5 43	0.31	1.17	2. 5	37.43
1892..	0.93	2.22	3.17	1.33	11.90	2.43	3.66	4 27	. 9	4.69	1.01	5.35	42 29
1893..	0.43	0.69	1.25	3.12	1.53	1.60	3. 0	5.65	3.20	0.06	1 26	1.69	24 28
1894..	3.74	1.11	4.79	2.82	1.87	3.71	1.66	1 95	1.65	1 84	0 07	1.51	2 .72
1895..	0.93	0.07	0.82	0.41	1.34	3.11	5.94	4.44	2.93	2.93	5.79	3. 8	32 49
1896..	0.45	0.14	1.03	1.02	4.62	3.22	1. 1	1.83	2 14	1.9	2.41	1.22	21 90
1897..	1.10	1.32	4.71	5.87	6.02	2.58	1 90	1 66	1.12	0. 1	0 58	0.70	28 47
1898..	4.38	2.37	2.34	0.95	9.96	1.75	4. 6	2.82	1.72	2.08	0.91	2. 4	35.88
Average	1.80	1.04	2.64	2.48	5.40	2.91	3.62	2.98	2.45	1.83	1.65	2.43	31.18

TULSA, CREEK NATION.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1889..	3.54	0.25	4.00	0.96	3.28	2.20	2.80	0.80	3.85	2.05	2.55	0.00	26.28
1890..	2.35	1.25	0.80	4.70	3.70	0.85	1.15	9.30	3.35	3.85	1.75	1.10	34.15
1891..	1.00	1.05	2.05	5.15	5.00	3.20	3.15	0.70	0.65	0.55	1.30	1 00	24.80
1892..	0.50	0.75	4.45	3.10	12.10	6.26	2.00	4.80	1.30	5.90	1.00	4.00	46.16
1893..	1.36	1.25	1.55	7.61	7.65	5.90	0.35	3.45	2.20	1.00	1.70	0.11	34.12
1894..	1.64	1.00	3.00	4.80	4.30	1.60	2.65	1.20	2.15	2.85	0.70	1 90	27.09
1895..	1.20	0.00	1.10	3.05	3.20	5.70	10.30	2.82	1.90	1.60	5.80	7.90	44.57
1896..	0.50	0.30	1.30	1.60	5.90	4.10	0.60	0.00	1.50	4.60	2.50	0.90	23.80
1897..	2.40	0.97	6.70	5.60	0.80	2.20	3.72	4.24	0.00	1.22	1.29	1 08	30.22
1898..	4.62	2.85	5.71	1.65	8.40	5.64	7.95	1.71	4.42	4.00	1.53	3.81	52.29
Average	1.91	0.97	3.07	3.82	5.43	3.76	3.47	2.88	2.13	2.76	2.00	2.12	34 35

FORT SILL, OKLAHOMA.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1889..	2.71	0.87	1.63	1.90	3.52	4.25	1.81	3.82	4.69	2.61	1.48	0.00	29.29
1890..	1.73	0.46	0.31	8.77	4.58	0.22	0.44	3.00	2.17	4.17	4.06	0.63	31.08
1891..	3.80	0.12	2.66	4.99	3.56	4.96	6.25	1.10	1.05	0 86	1 10	2 72	32.76
1892.	0.51	1.23	2.05	2.56	7.20	2.60	1.52	4.06	3.57	5.69	0.35	2.98	34.32
1893..	2.95	1.17	1.36	0.37	3.50	0.51	1.91	4.70	3.65	0.00	1.30	2.77	24.19
1894..	1.70	0.72	2.82	4.03	4.20	1.04	1.91	2.47	3.45	1.09	0.00	0.65	24.08
1895..	0.56	0.54	0.20	0.43	2.92	3.92	6.28	2.10	0.06	4.59	5.53	2.01	29.17
1896..	1.40	0.41	1.23	1.63	1.26	1 38	1.21	1.66	0.81	1.55	1.83	2 75	17.12
1897..	1.50	0.39	2.62	0.80	8.07	2.80	1.95	2 37	1.75	2.73	0.49	0 82	26.89
1898..	1.69	2.20	3.24	5.86	6.53	4.00	2.20	4.50	2.07	1.66	1 00	2 49	3 .25
Average	1.86	0.81	1.81	3.13	4.54	2 57	2.55	2 98	2.33	2 50	1 72	1.77	28.56

FORT SUPPLY, OKLAHOMA.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1885..	0.38	0.74	1.48	8.60	7.56	5.44	4.17	0.62	3.41	1.00	1 07	3.19	37.66
1886..	0.76	0.40	0.34	1.73	0.06	3.54	0.93	0.92	0.20	1.32	0.10	0 00	10.35
1887..	0.00	0.00	0.00	1.64	2.37	2.96	1.06	2.98	2.24	0.53	0.30	0.64	14.75
1888..	0.30	0.82	0.18	4.42	2.72	0.84	1.18	2.30	1.20	0.90	0 38	0.76	15.50
1889..	0.90	0.10	2.11	1.33	2.29	2.90	2.17	3.45	2.02	4.99	1.35	0.00	23.61
1890..	1.80	0.18	0.00	2.98	2.21	2.37	1.74	3.33	1.29	0.74	1.18	0 09	18.21
1891..	2.67	0.60	2.89	0.28	3.75	4.85	8.12	0.90	1.52	2.33	1.21	1.31	30 43
1892..	T	2.02	3.02	0.55	4.48	0.65	1.55	4.52	1.15	1.85	0.40	1.80	21.99
1893..	0.02	0.62	0.20	0.25	1.43	0.74	1.60	4.37	2.72	0 00	0.70	0.50	13.15
1894..	0.25	1.04	0.12	4.36	5.22	1.31	2.63	0.26	2.29	0.49	0.25	....	.. ..
Average	0.71	0.65	1.03	2.61	3.21	2.53	2.52	2.26	1.80	1.42	0.73	0 78	18.57

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STILLWATER, OKLAHOMA.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.	Annual.
1895..	....	....	....	....	2.27	5 03	3.60	4.97	1.50	1.59	4.09	3.08	.. ..
1896..	0.55	0.19	1.21	0 94	5 93	7.26	5.85	1.04	2.54	2.88	1 56	0 5	.80
1897..	0.81	1.51	3.51	6.30	4.77	4.13	2.63	4.51	0.11	0 97	0 8	0.87	31.52
1898..	3.53	3.00	2.75	0.58	8.56	4.72	6.35	2.83	2.72	4 19	0.68	2 8	42.62
Average	1.63	1.57	2.49	2.61	5.38	5 30	4.61	3.84	1.89	2 41	1 98	1 95	34.18

CLIFTON, OKLAHOMA.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.	Annual.
1894..	3.35	1.45	3.12	4.78	2.42	1.08	1 08	0.35	1.81	1.12	0 5	1.23	2.29
1895..	1.41	0.27	0.90	0.84	0.67	10.32	4.61	5 90	0.13	2.77	5 53	4.84	38.9
1896..	0.77	0.23	0.95	0.69	2.01	3.12	1 96	1.96	2.51	1.21	3.31	0.71	19.43
1897..	1.19	1.25	4.82	9.22	3.61	2.64	3.63	2.73	0.60	1.26	0 77	0.97	32.64
1898..	4.17	2.57	4.36	1.26	10.64	2.96	2.74	2.82	0.78	2.79	0 90	2.76	38.75
Average	2.18	1.15	2.83	3.36	3.87	4.02	2.80	2.75	1.17	1.83	2.20	2.20	30 7

ARAPAHO, OKLAHOMA.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.	Annual.
1894..	0.78	0.50	0.88	4.87	2.01	4.82	2.22	0 90	2.52	1.59	T	0.38	21.47
1895..	1.01	2.09	0.06	1.35	1.74	5 90	5.08	5 46	1.15	2.84	3 10	1.25	3 .03
1896..	1.51	0.22	0.86	1.70	1.60	5.04	4 77	1.26	2.36	2.37	0.65	2 85	25.79
1897..	1.56	0.46	1.71	4.22	8.80	2.85	1.74	1.85	2 30	0.99	0.18	0.23	26.69
1898..	0.94	2.62	1.79	1.39	6.43	5.60	9.82	1 22	1.97	0.79	0.98	2 09	35. 4
Average	1.16	1.18	1.06	2.71	4.12	4.84	4.73	2.10	2 03	1.72	0.98	1 16	28 00

WINNVIEW, OKLAHOMA.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.	Annual.
1893..	....	2.19	0.98	1.82	2.24	3.73	2.90	7.31	1.44	T	1.45	1.90	25.86
1894..	1.40	0.70	1.68	6.05	3.37	1.95	2.44	0.85	3.28	1 33	T	0 53	27.98
1895..	1.19	1.02	0.02	0.99	2.79	4.31	2.83	5.71	0.86	1.83	3 17	1 57	26 19
1896..	2.10	0.08	0.67	0.99	0.71	3.71	6.14	1 33	2 46	1 96	0.41	1.26	21 72
1897..	1.53	0.81	2.29	4.49	7.42	2.33	1.54	1.08	2.25	2.33	0 03	0 42	2 .55
1898..	2.01	3.55	1.56	1.08	13.38	2.88	6.90	2.58	1.13	1.63	0 8	2 05	70 63
Average	1.65	1.39	1.20	2.55	4 98	3.05	3.79	3.14	1.90	1.52	0 99	1 41	27 32

JEFFERSON, OKLAHOMA.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.	Annual.
1894..	1.74	1.03	0.22	4.02	2.15	0.61	1.11	2.16	2.22	2.05	0.03	0.90	17.69
1895..	0.98	0.49	0.05	0.62	1.18	6.36	4.17	3.27	0.34	0.78	0 90	1.35	21.53
1896..	0.65	0.20	0.86	1.25	1.00	4.76	5 69	0.72	4.17	5.55	0.38	0.43	2 .01
1897..	0.91	1.02	2.65	5.80	4.93	5.15	1.15	5.48	1.76	0.72	0.00	0 51	29.70
1898..	2.32	2.55	1.43	1.61	7.53	7.42	3.27	6.40	1.27	1.25	0.65	2.84	38.54
Average	1.32	1.03	1.04	2.66	3.36	4.58	3.08	3.61	1.87	2.13	0.62	1 09	26.70

MANGUM, OKLAHOMA.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.	Annual.
1893..	0.25	0.81	0.55	0.33	1.55	1.34	0.97	3.19	1.62	0.08	0.10	0 67	11.89
1894..	1.01	1.21	0.67	2.98	2.94	2.44	0.93	3.25	1.45	2.51	0 00	0 19	19 52
1895..	0.40	3.07	0.09	0.69	1.14	11.54	6.33	2.82	T	3.79	2 25	0.9	32 81
1896..	1.67	0.90	0.10	1.75	1.76	3.38	4.97	0.95	1.34	1.87	0.61	3.5	2 .85
1897..	1.82	0.28	1.48	2.72	3.52	3 23	2.28	2.91	2.78	0.92	0.36	0 21	22 49
1898..	1.36	3.38	1.32	1.12	5.17	7.79	2 62	3.41	1 45	0.69	0.55	2 14	30 91
Average	1.08	1.60	0.68	1.60	2.68	4.95	3 02	2.74	1.44	0.62	0 65	1 28	23.34

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SUMMARY OF RESULTS OF EXPERIMENTS.

John Fields.

INTRODUCTION.

The increased interest in the work of the station is resulting in a demand for information contained in bulletins that are now out of print and has made it necessary that this information be summarized and published in some form. It has been thought better to treat the work of the station by topics rather than by departments since much of the work on investigations is done by two or more departments working in conjunction. Accordingly, under each subject will be found the results of work done. All of the work of the station is not reported but only such portions as have led to some result, either positive or negative, of a practical and scientific character. This plan serves to eliminate much distracting matter and will, it is believed, place the work of the station in its proper light before the people. Full details of any of the experiments here reported will be gladly furnished by correspondence. The station, because of limitations imposed by the law establishing it, is prevented from undertaking many lines of inquiry considered by some very desirable. Operating as it does under an act of Congress which prescribes the manner of expenditure of the funds from the national treasury and for the proper accounting of the same, the station alone can determine what is the proper work for it to do. The work has been made as broad as possible as the report of the Director and the following summary will show.

WHEAT.

1. *Variety tests.* Tests of varieties of wheat have been conducted continuously since the establishment of the station and the results reported in five bulletins, Nos. 8, 12, 20, 28, and 36.

In 1893, 254 varieties were tested, the following being the highest yields secured: Silver Chaff, 24.0; Michigan Amber, 24.0; Missouri, 20.7; Currell, 20.3; Mediterranean, 19.3; Mennonite, 18.3 bushels per acre.

In 1894, 50 varieties were tested in duplicate on manured and unmanured land. The average yield of the two plats for the best

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varieties was the following: Nigger, 27.9; Nebraska, 26.8; Currell, 26.4; Velvet Chaff, 26.4; Silver Chaff, 23.8; Missouri, 22.4 bushels per acre.

In 1895, the wheat crop was a failure and no results were obtained.

In 1896, 71 varieties were tested. The best bearded varieties yielded as follows: Hybrid Mediterranean, 29.5; Nigger, 29.5; Mo. Blue Stem, 27.5; Sibley's New Golden, 27.3; Deitz Longberry, 27.0 bushels per acre. The best smooth varieties yielded as follows: Michigan Amber, 28.0; Early Red Clawson, 21.8; Fuller's German Emperor, 20.0; Badger, 19.7 bushels per acre.

In 1897, 64 varieties were tested, the following being the highest yields secured: Fultz, 57.0; Red Russian, 51.3; Sibley's Blue Stem, 27.5; Sibley's New Golden, 27.3; Dietz Longberry, 27.0 50.0; Oregon Swamp, 50.0 bushels per acre. The yields in this experiment were remarkable and are summed up as follows in Bulletin No. 28, June, 1897. "The eighty-three plats gave an average yield of 39.6 bushels per acre. Eight plats gave yields between 50 and 57; fourteen between 45 and 50; twenty-four between 40 and 45; fifteen between 35 and 40; twelve between 30 and 35, and eleven less than 30 bushels per acre. The smallest yield was at rate of 19.5 bushels."

In 1898, 54 varieties were tested. "The largest yields were: Early Red Clawson, 35.2; Big English, 34.5; Fultz, 33.4; Fulcaster, 32.2; Red Russian, 30.0 bushels per acre." (Bul. 36.) "Of these, the three last named were among the best in the yields in 1897 and are counted as desirable as any tested."

While it is true that these results are local and do not give a complete estimate of the value of the different varieties for all parts of the Territory, it is not probable that a variety that has continuously failed here would be a success in other localities. The following summary of results taken from Bulletin No. 36 contains a list of varieties which have done best at the station, any one of which might give the highest yield in certain sections.

"For the two years 1897 and 1898, the following varieties have given average yields of over 40 bushels per acre—taking the yield from the best plat in each case: Fultz, 45; Red Russian, 42; Fulcaster, 41. The following have given average yields of from 35 to 40 bushels: Early Red Clawson, Big English, Missouri Blue Stem, Sibley's New Golden, Mealy, Crate, and Lebanon. The following from 30 to 35 bushels: Dietz Longberry, Nigger, Bearded Monarch, German Emperor, Extra Early Oakley, Longberry, Miami Valley, Early Ripe, Saskatchewan, and Valley. With two or three exceptions, each of these varieties gave relatively good yields in 1896."

2. *Preparation of soil.* Trials in 1897 resulted in but little difference in yield on subsoiled and un-subsoiled plats and in 1898,

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"no perceptible benefit came from rolling the land in addition to harrowing it before seeding."

In 1894, comparisons were made of 51 varieties grown on duplicate plats with and without manure. Twenty loads of fresh stable manure (from horses) were applied to the acre and plowed in a few days before seeding. The average yield per acre for the manured land was 32.4; for the un-manured, 14.4 bushels per acre.

3. *Quantity of seed.* In 1896, "no important difference in yields came from sowing widely differing quantities of seed per acre, especially in fairly early seeding. A plat sown at rate of three pecks per acre gave nearly as large a yield as one sown at rate of eight pecks per acre."

In 1897, "the best yields were from plats sown at the rate of six pecks per acre, but the largest yield from one plat was from sowing at rate of five pecks per acre. In some cases there was no great difference in yield, whether three or eight pecks per acre were sown."

In 1898, "plats were sown at intervals at rate of 3, 4, 5, 6, and 8 pecks per acre." The average yield increased with the thicker seeding and thick seeding is considered safest in unfavorable seasons.

4. *Time of seeding.* In 1893, seeding beginning October 10th gave better yields of grain than seeding from November 14th to 24th.

The results of trials in 1894 led to the following advice: "Sow wheat as early as possible after September 1st. Put it 'in the dust' if you have no rain."

In 1896, "In special trial of different dates of sowing, there was a steady decline in yield from sowing October 1st up to December 10th."

In 1897, the largest yield was from sowing September 15th and nearly as large from sowing September 25th. Good yields were obtained from sowing October 5th, but later sowing gave still smaller yields.

In 1898, "neither very early nor late sowing proved best; generally the best yields were from sowing September 25 to October 5th."

These experiments, taken as a whole, indicate that higher yields may be expected from wheat sown from September 15th to October 5th than from that sown either earlier or later. The character of the season and the condition of the soil will modify these limits which are not to be taken as absolute.

5. *Feeding wheat.* Bulletin No. 13, issued in December, 1894, at a time when low prices led to the feeding of wheat to farm animals, summarized what was known of the subject at that time.

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The matter was of but temporary interest and served a useful purpose when it was issued.

6. *Spring wheat.* Three varieties tested in the spring of 1892 yielded as follows: Wellman, 8.2; Blue Stem Velvet Chaff, 7.7; Saskatchewan, 6.1 bushels per acre.

CORN.

The experience and observation of the station extending through a period of seven years show that, in general, corn should be grown on the bottoms and Kafir on the upland. In the experiments mentioned later, seasons have occurred when corn on the bottoms yielded 50 bushels or more per acre while that on the upland was not worth the husking.

1. *Variety tests.* Tests of varieties of corn were reported in Bulletins No. 10, 21, 33, and 36. There is great confusion in the naming of varieties, the same one frequently being known by several different names in different localities. The tests show that seed should be selected from the best yielding varieties in the neighborhood where the corn is to be grown. Plants become adapted to the climate and locally grown seed will be found to give better results, in the long run, than any imported seed. Careful selection of perfect seed-corn by each farmer will improve the crop and usually be found most satisfactory.

Cornucopia, or "seven eared" corn was tried in 1898 and yielded less than 15 bushels per acre. "Brazil Flour corn" gave a yield of 21 bushels per acre which was less than half the yield obtained from a locally grown, medium early, white variety.

2. *Preparation of soil.* Deep plowing is preferable in all cases. Comparisons of land plowed four inches with that plowed eight inches deep resulted in the latter giving the higher yield. The deeper plowing permits the soil to take up the rain that falls and to hold it for the needs of the crop when dry weather comes.

3. *Drilling or listing?* In 1896, drilled and listed corn were planted side by side, one plat of each per week from March 21st to April 25th. The drilled corn, with but one exception, yielded better than the listed. The average yield of the plats drilled with the corn planter was 14 per cent. greater than that of the listed plats.

4. *Time of planting.* This must of necessity vary with the character of the weather. In 1898, beginning March 28th, plats were planted each week until April 25th; also one on May 13th. The largest yield was from the first planting, the next from the third. Aside from this, there was a steady decrease in the yield with later planting, except that planting May 13th gave a larger

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yield than planting three weeks earlier. In former years, differences in time of planting did not give corresponding differences in yield.

In this, as in most other cases, it is not possible to lay down a fixed and unalterable rule. Individual judgment and experience must be brought to bear in deciding when to plant each season's crop.

5. *Thickness of planting.* Results of experiments are reported in Bulletins No. 21, 33, and 36. In 1897, a trial was conducted on bottom land, the corn being planted at different distances in rows 3 ft. 8 in. apart. The smallest yield of corn was 46 bushels per acre, the stalks being 6 inches apart in the row; the largest, 63.5 bushels, with two stalks each 30 inches; the next largest, 62 bushels, with one stalk each 18 inches.

A duplicate of this experiment was conducted on upland, but on account of dry weather, no well-developed ears were produced and none of the corn was husked.

In 1898 on upland, the best yields were from planting at the rate of one kernel each 12 inches in rows 3 ft. 8 in. apart. The yields averaged less where the rows were three feet apart.

6. *Cultivation.* Experiments in frequency and depth of cultivation have not been conclusive but indicate that a small number of shallow cultivations is sufficient in ordinary seasons. In 1898, the kind of implement used seemed to make little difference and a plat cultivated twice gave a larger yield than those cultivated even nine times.

KAFIR CORN.

The experiments summarized under this heading refer only to the production of Kafir corn, the thrashed grain.

1. *Variety tests.* Four varieties have been tried: Black-hulled white Kafir, white Kafir, red Kafir, and Black Rice corn. The first might more appropriately be called "black-husked" white Kafir, as the grain is white and but little different from that of white Kafir, the husks of which are white. These two varieties have squared-ended heads carrying their width well toward the base. The heads of red Kafir are longer, looser, and more branching than those of the white variety; the grain is dull red in color. Black Rice corn is classed as one of the Kafirs and has smaller heads than the other varieties.

Trials conducted during the seasons of 1896 and 1897 showed that either of the white varieties yielded better than the red on the station farm. Accordingly, in the experiments of 1898, only the black-hulled white variety was grown.

2. *Time of planting.* Experiments covering this point indicate

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that Kafir may be planted later than corn, due regard being taken of the character of the season. In 1897, planting on May 15th and 22nd gave yields of 38.2 bushels per acre; planting on April 17th and May 1st yielded 22.3 bushels. In 1898, planting on May 13th and 24th gave higher yields than planting on April 4th, 11th, 18th, 25th, or on June 3rd.

3. *Thickness of planting.* Experience has shown that Kafir should be planted closer than corn. In 1897 with stalks three inches apart in rows three feet apart, a yield of 53.3 bushels was secured. Higher yields were secured from rows three feet than from rows either 30 or 44 inches apart, the plants being the same distances apart in the rows in each case.

These results were corroborated in 1898 when four plats with rows three feet apart and one stalk to each four inches gave an average yield of 85 bushels per acre. Ten plats, with one stalk to each 8 inches and rows three feet apart yielded 45 bushels per acre. Greater distances gave decreased yields.

It is believed that for average upland soils, Kafir should be planted in rows three feet apart with one stalk to each three or four inches when the crop is grown for the grain that it will produce.

4. *Corn or Kafir, which?* It depends upon where and for what purposes the grain is to be grown.

On bottom land when the crop is to be sold as soon as matured, plant corn. It is always a marketable article at some price, depending usually on the volume of the local supply. If the grain is to be fed to stock, it would seem advisable to replace a portion of the corn by Kafir, especially for the large amount of rough forage which the latter affords.

On upland, corn is not a sure crop while Kafir has not yet, even in the dryest seasons, failed to yield well. In 1897, when dry weather, high temperature, and hot winds affected the corn so that no well-developed ears were produced, Kafir planted alongside yielded from 25 to 53 bushels of grain per acre. In 1898 when corn did well, Kafir surpassed it on upland, one plat yielding at the rate of 102 bushels of Kafir corn per acre.

On bottom land, plant corn or Kafir; on upland, plant Kafir.

COTTON.

A prominent place in the diversification of crops in Oklahoma should be assigned to cotton. It should be grown along with a number of crops in a system of general farming rather than be relied upon as the only crop. The large amount of unpicked cotton left each season is evidence of some serious miscalculations in

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planning the crops to be grown. It is not believed that it will be found profitable, as an average of a number of years, to grow more than 10 acres of cotton to each farm. Exclusive cotton-farming has not paid in the South.

"The following paragraph by Mr. Harry Hammond, an extensive cotton-grower in South Carolina, refers to the great cotton-growing regions, but has much of suggestiveness to Oklahoma farmers:

"The general testimony is that, while farmers growing cotton exclusively are in very bad condition financially, those who raise food and forage, and especially those who in addition raise their work animals, are everywhere prosperous. The exclusive cotton-grower fails to employ the most important forces in farm work—the work animals and the land—to the fullest extent. He draws upon the surplus of a single crop made in part of the year for the means to support his farm during the whole year. There is a saving in using unemployed time and capital to produce necessaries which otherwise must be paid for in money. The tendency to pay greater attention to food and forage crops has been much accelerated by the low price of cotton since 1890." (Bulletin 23).

In February, 1897, a bulletin on "Cotton culture in Oklahoma" was issued by the station. General cultural directions were given and the experience of a number of farmers was summarized.

Experiments were conducted by the station in 1897 and reported in Bulletin 33. In the comparison of varieties, Southern Hope, King Improved, and Storm King gave good yields. Trials of Egyptian varieties showed that they were too late in ripening to be of value in this climate. A steady decrease in yield was secured from the first to last planting. In 1898, however, the time of planting did not sensibly affect the yield. Planting early so as to prolong the season is desirable.

The tests of thickness of planting were not conclusive but emphasized the value of securing a good stand. Thick planting, within certain limits, tends to hasten maturity which is desirable. The highest yield in 1898 was from planting in rows 42 inches apart and thinning to one plant each 17 inches, the next was from rows 4 feet apart with one plant every 10 inches.

The uses to which cottonseed may be put are indicated on page 68.

CASTOR BEANS.

This crop is increasing in importance and is rapidly taking its proper place as one of many crops, rather than the one crop, which should be grown.

1. *Time of planting.* In 1897, the largest yield, 12.9 bushels

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per acre, was from planting on April 13th, but planting as late as May 19th gave 10.4 bushels. There was a corresponding difference in time of first picking, the earlier planted plats being ready on July 21st; the later on August 17th. In 1898, planting on April 8 gave 11.4, and on April 29 and May 13th, 11.3 bushels per acre.

2. *Thickness of planting.* Trials in 1897 indicated that one plant every 15 to 18 inches in rows 42 to 48 inchest apart was thick enough. In 1898, the best yields were from planting in rows 3 feet apart with one stalk each 9 to 12 inches.

3. *Selection of seed.* The beans usually grown are all "castor beans," no varieties being distinguished. Well-formed spikes from plants carrying the largest number of good blooms should be selected while gathering the crop, and kept separate for the next year's seed. Unless this is done, the character of the seed, on which so much depends, will be poor and give an irregular stand with many worthless plants. Careful selection of seed, on the other hand, will improve the stand, the yield, and the quality of the crop. In one trial covering this point, a gain of two bushels per acre was obtained by planting selected seed.

4. *Poisonous properties.* No part of the plant is available as food for animals. Many cases have been reported where horses ate of the beans and almost invariably died. The exact cause of death has not been determined but in the opinion of the Veterinarian of the station, the beans contain some quick-acting poison. No trouble has been experienced from animals eating other parts of the plant.

5. *Effect on the soil.* This is discussed on page 69.

OATS.

Variety tests of oats were reported in Bulletins 4, 16, and 33. In 1897, the following yields were obtained: Texas Red, 49.4; Negro Wonder, 43.5; Black Russian, 33.2; Lincoln, 31.8 bushels per acre. This is the same order in which these varieties yielded in 1896.

ALFALFA.

Ever since the establishment of the Experiment Station, an effort has been made to find some crop for hay. Grasses have been repeatedly tried, tenderly nursed, and so far proven unsuccessful. Clovers, white, red, and alsike, have had a great deal of attention but none have done so well as to give promise of permanently paying yields of either hay or pasturage. While a few grasses and clovers have shown some adaptability, none can yet be depended

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upon to yield a paying crop when sown on any considerable area. None of them, in so far as experience at the station goes, can be sown with any degree of certainty that a ton of hay per acre will be obtained.

Alfalfa, on the other hand, has been proven to be reasonably well-adapted and to give yields of hay up to three or more tons per acre. In 1897, an acre of alfalfa on the upland station farm gave 6055 lbs. of well-dried hay at three cuttings. Good yields were also obtained in the season of 1898 and alfalfa on the station farm in the spring of 1899 is in excellent condition.

1. *Character and preparation of the soil.* Alfalfa has a long tap-root and will not do well on soils with hard-pan close to the surface. As a general rule, the better the land has been cultivated and the deeper it has been plowed and subsoiled, the better will alfalfa thrive. Land that has been in corn, Kafir, or cotton and yielded good crops is usually fitted for the production of alfalfa. Subsoiling, when practiced, should be done long enough before sowing to allow the soil to settle and become reasonably firm.

2. *Time of sowing.* The seed may be sown either in late summer, fall, or spring. Good stands and failures may be expected at any of these times, depending on the weather conditions after the plants come up and while they are young and delicate. Trials at the station have resulted in successes from sowing twice in early August and on three occasions in the spring.

3. *Hay or pasture?* When a good stand of alfalfa has been secured, it is a permanent improvement to the farm if it is properly managed. The plants, once established, continue becoming stronger and live for a number of years.

Alfalfa should be cut for hay when in about full bloom and requires more care in making than does prairie hay. The leaves are easily broken off when dry and contain much of the nutritious material of the plant. The curing and stacking of alfalfa hay is an art to be learned by experience and observation; the stacks should be protected by a covering of prairie hay or straw. Three cuttings may be secured, one in May, one in June, and one at a later period depending on the rainfall and temperature.

Failures with alfalfa are reported frequently. Is it not possible that a large proportion of these failures is caused by too close pasturing? There is no question but that alfalfa is good for hogs but it is not so clear that hogs are good for alfalfa. Many fields of alfalfa are ruined by too close pasturing. The crowns of the plants are injured by animals tramping on them and cropping them too closely. The plant is weakened and dies and "alfalfa has failed." The station has conducted no experiments on the effect of pasturing alafalfa but has noted the effect in many sections of the territory. This observation has led to the belief that alfalfa

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should be regarded mainly as a hay crop and only incidentally as affording pasture. Rough places covered with native grasses should not be broken out but fenced and used for the latter.

4. *Feeding alfalfa hay.* The uses to which alfalfa hay is put where it is grown extensively, and its composition, indicate its proper place in the economy of the farm. It is a rich feed containing more of the muscle-making nutrients than any of the coarse fodders or prairie hay. It should be fed in conjunction with corn and Kafir fodders and with corn and Kafir meals. With them, it makes more nearly what is called a "balanced ration" for growing and milk-producing animals; a ration which is nearer to their actual needs than one composed exclusively of corn or Kafir products.

COWPEAS.

Realizing that some easily-grown and nutritious forage crop was needed in Oklahoma, the station for a time conducted cooperative experiments with cowpeas and encouraged their culture. The general results of these experiments were satisfactory and showed that cowpeas do well in many sections of the territory. The following brief summary of methods of growing and using cowpeas is taken, for the most part, from Farmers' Bulletin No. 89 of the U. S. Department of Agriculture.

1. *Cultivation and harvesting.* "Cowpeas are planted broadcast or in drills, very commonly between the corn rows after the crop is laid by. The amount of seed varies from four quarts to 2 bushels per acre, the average amount being, perhaps, about three pecks. The seed will stand being covered to the depth of 2 or 3 inches, but care must be taken to plant when the ground is neither too wet nor too cold, as the peas rot very rapidly under such circumstances. It must be remembered that this plant originated in the Tropics and that when transplanted to higher latitudes it makes its best growth in the hottest weather. Where the vines are grown for hay, the yield will be larger if the seed is planted in drills and cultivated a time or two."

"The vines should be mown for hay when the peas are well-formed and the leaves and pods are first beginning to turn yellow. After wilting on the ground or in windrows from twenty-four to forty-eight hours, the hay is placed in small, thin piles, or cocks, and allowed to cure for several days, when it may be carted to the barn or stacked under sheds. The haymaking process is a difficult one, requiring more care and attention than in the case of red clover, because the broad leaves and thick stems contain a large amount of water. The hay must be placed in cocks before the leaves become brittle, and the piles must be small enough to allow

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free circulation of air to the center of each. Bright cowpea hay, clean and well-cured, is worth as much as the best red-clover hay." The hay is frequently stacked in the field and covered with straw or grass for protection."

"The bush varieties are the best for hay, because of the greater ease with which they may be mowed and handled." The yield of hay varies from two to four tons per acre depending on the fertility of the soil and method of growing. "Its feeding value is equal to that of the best red clover, and the hay ranks high in palatability and digestibility."

2. *For swine and cattle.* "When cowpeas are planted for green manure, (see page 69) it is an excellent practice to turn hogs into the field about the time that the first peas are ripening. Young pigs thrive amazingly on the succulent foliage and well-filled pods, and the quality of pork raised on such a healthful and nutritious diet is very fine. This is a profitable method of fattening hogs or of preparing them for topping off with corn or sorghum for market. An acre of ripening cowpeas will pasture from fifteen to twenty hogs for several weeks, and the gain in fertility from the droppings of the animals during that period will more than counterbalance the fertilizing value of the forage eaten. The rapid increase in weight will thus represent so much clear profit, and the farmer is richer by half a ton or more of prime pork for every acre planted. Chickens and turkeys also eat the ripe peas and do well upon them.

Cattle and horses are sometimes pastured on them, but the safer and more economical way of feeding the green cowpea vines to such stock is to cut or pull and feed partially wilted. There will be less waste and destruction from trampling, and if each animal is given only so much as it can eat clean, the greatest enconomy as well as the greatest profit will result. Furthermore, cattle and sheep are liable to bloat if allowed to eat too ravenously of cowpea vines or any other rich and succulent forage, and by using it as a soiling crop the danger may be more readily controlled and the loss prevented."

3. *Harvesting the seed.* "The majority of farmers harvest only enough seed of cowpeas to plant again next season. The ripe pods are picked by hand and are stored in barrels until needed or are thrashed out by machine. The yield per acre varies according to the variety and method of cultivation. Eight to 12 bushels is a fair average of the amount that can be obtained when the peas are planted in the corn rows. Sown alone, broadcast or in drills, yields of from 20 to 35, and even in rare cases, 50 bushels are obtained. The Black, Unknown, Red Ripper, Clay, and Calico varieties are all heavy seed bearers. The Black-eye, Red Crowder, and Whippoor-will, or Speckled, are very widely cultivated and find ready sale."

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STOCK MELONS.

Stock or "pie" melons grow readily and afford a large yield of stock food with but little trouble. An analysis reported in Bulletin No. 25 showed that they contain 93 per cent. of water and that one ton of melons contains about as much real food material as 525 pounds of green corn fodder, or 235 pounds of corn stover (fodder after husking).

SUGAR BEETS.

1. *For sugar making.* Experiments, in co-operation with the U. S. Department of Agriculture, were conducted during the seasons of 1897 and 1898, and are being continued this season.

The results of two seasons' work are summarized as follows:

1. It has not been found that beets of sufficiently high grade for sugar manufacture can be grown on a commercial scale in Oklahoma.

2. During the season of 1897, 21 samples were analyzed representing 11 counties. They showed a mean percentage of sugar in the juice of 12.0 and a mean coefficient of purity of 65.3. But one sample contained more than 12. per cent. of sugar in the juice with a coefficient of purity of 80, which is the standard for sugar manufacture. A sample representing another county was analyzed at Washington; the percentage of sugar in the juice was 12.4 and the coefficient of purity 72.5.

3. During the season of 1898, 19 samples were analyzed representing 10 counties. They showed a mean percentage of sugar in the juice of 9.4 and a coefficient of purity of 67.6. As in 1897, there was but one sample of sufficient purity and richness for sugar manufacture.

4. Combining the results of 1897 and 1898, 41 samples representing 14 counties have been analyzed, showing a mean percentage of sugar in the juice of 10.8 and a mean coefficient of purity of 66.5. Of the 41 samples examined, but two were of a quality suited to sugar manufacture.

2. *For stock feeding.* Yields of 20 tons per acre of sugar beets have been secured. They make excellent feed for cows and are much relished by them during the winter months when coarse forage is dry and not very palatable. It is not thought, however, that it would be found profitable to grow them extensively for this purpose. For a change of feed or an addition to dry forage, they are of value.

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FRUIT ON THE STATION FARM.

Early in the history of the station, an extended series of tests of varieties of fruits was planned and begun. Seven years have elapsed since the first start was made, yet the time has not been sufficient to permit the making of the positive statements frequently demanded of the station by fruit-growers and others. It is yet too early to state with certainty what many varieties will do in this climate. Deductions based entirely on the results secured at the station are not of as certain value as when supported by observation of the methods employed at different places in the territory and the results produced. The station is working on this subject and hopes, after observing and studying the work of a few more years, to issue a reliable and trustworthy report on the fruit industry of Oklahoma.

In the brief notes that follow will be found a portion of the record of the work with fruit. Measurements of the circumference of the trunks of the trees, one foot from the ground, are given as an imperfect estimate of the general vigor of growth of different varieties. The orchard has had clean cultivation with the exception of an occasional crop of cowpeas late in the season.

APPLES.

The following varieties of apples fruited in 1898: Broadwell, Cannon Pearmain, Cole's Quince, Crawford, Hockett's Sweet, Keswick Codlin, Lowell, Late Strawberry, Maiden's Blush, Moon, Mammoth Black Twig, Nansemond Beauty, Pomeroy, Talman's Sweet, Wagener, Water, Yopp's Favorite.

The following varieties of apples set fruit in 1899: American Summer Pearmain, Alexander, Arkansas Beauty, Arkansas Black, Bledsoe, Black Annette, Carolina Watson, Cullen's Keeper, Crawford, Cole's Quince, Domine, Dickinson, Early Ripe, Fenley, Fallawater, Gano, Hightop Sweet, Ingram, Indian, Jones' Seedling, Kittageskee, King, Kansas Queen, Lowell, Limber Twig, Maiden's Blush, Missouri Pippin, Moon, Nantahalee, Nero, Pyle's Red Winter, Porter, Rambo, Rhode's Orange, Stewart's Golden, St. Lawrence, Twenty Ounce, Talman's Sweet, Wagener, Water, Willow Twig, Yopp's Favorite.

The following varieties bloomed in 1899 but set no fruit: Yellow Transparent, Jefferis, Jewett's Best, Kentucky Red Streak, Shockley, Black Warrior, Chattahoochie, Chester Early White, Family Favorite, Vandevere, Early Pennock, Kinnard's Choice, Lawver, Mammoth Black Twig, McIntosh Red, McMahon, May, Nansemond Beauty, Roman Stem.

Trees set in 1892 that measure more than 12 inches in circumference of trunk: Rhode's Orange, Jewett's Best, Duchess of Oldenburg, Flory's Bellflower, Moon, Maverack, Arkansas Beauty,

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Arkansas Black, Autumn Bough, Chester Early White, Cullen's Keeper, Early Pennock, Trenton Early, Enormous, Fallawater, Fameuse, Vandevere, Indian, Lawver, McMahon, Minkler, Nickajack, Stewart's Golden, McAfee, Kentucky Red Streak, Ortley Bellflower, Rutledge.

Trees set in 1892 that measure between 10 and 12 inches in circumference of trunk. Early Colton, Early Harvest, May Pippin, White Juneating, Carolina Red June, Large Yellow Bough, Hightop Sweet, Yellow Transparent, Carolina Watson, Kansas Queen, American Summer Pearmain, Nantahalee, Early Strawberry, Keswick Codling, Benoni, Disharoon, Fenley, Duchess, Yopp's Favorite, Maiden's Blush, Hoover, Pomeroy, Porter, Twenty Ounce, St. Lawrence, Kittageskee, Alexander, American, Golden Russet, Black Annette, Cole's Quince, Domine, Elkhorn, Jersey Sweet, Forest, Kinnaird's Choice, Mammoth Black, Mammoth Black Twig, Mammoth Pippin, Sweet Dixon, McIntosh Red, Mason's Orange, Nero, Plum Cider, Pyle's Red Winter, Rhode Island Greening, Shackelford, Wagener, White Pippin, Willow Twig, Utters Red, Isham Sweet, English Sweet, Lauren's Greening, White Spanish Reinette, Shockley, Cobbett, Mother, Pewaukee, Rambo, Talman's Sweet, Rebel.

Trees set in 1892 that measure between 8 and 10 inches in circumference of trunk: Red Astrachan, Early Ripe, Charlottonthaler, Cooper's Early White, Fanny, Primate, Northern Sweet, Lowell, Bledsoe, Carter's Blue, Carolina Greening, Bostic Queen, Mrs. Bryan, Ortley, Colvert, Ohio Pippin, Shannon, Tuscaloosa, Celestia, Dr. Walker, Moultrie's Babbitt, Chattahoochee, Clayton, Cornell's Fancy, Crawford, Dickinson, Family Favorite, Gideon, Huntsman's Favorite, Ingram, Jones' Seedling, King, Longfield, Loy, Mammoth Pippin, Marshall Red, May Nansemond Beauty, Northwest Greening, Orchard Red, Poorhouse, Pryor's Red, Red Riches, Limber Twig, Romanite Gilpin, Roxbury Russet, Scarlet Cranberry, Smith's Cider, Water, Stump, Roman Stem.

Trees set in 1892 that measure less than 8 inches in circumference of trunk. Simmons Red, Sops of Wine, Gravenstein, Jefferis, Red Betigheimer, Red Winter Pearmain, Buckingham, Late Strawberry, Rambo, Broadwell, Cannon Pearmain, Eureka, Gano, Osceola, Foundling, White Winter Pearmain.

Trees set in 1892 but now dead. Summer Queen, Stewart, Spencer, Oldenburg, Tetofsky, Bailey's Sweet, Rawle's Janet, Mangum, Stevenson's, Yates, Bethel, Etowah, Horn, Pickard's Reserve, Royal Limber Twig, Sonoma.

PEARS.

Trees set in spring of 1895, trunk measuring more than 9 inches in circumference. Forest Beauty, Kieffer.

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Trees set in spring of 1895, trunk measuring between 7 and 9 inches in circumference. Beauty, Lawson, Buffum, Early Harvest, L. B. de Jersey.

Trees set in spring of 1895, trunk measuring less than 7 inches in circumference. Buffum dwarf; Clapp's Favorite, Seckel dwarf, Lawrence, Shelton, Duchess dwarf, Bartlett dwarf, Clapp's Favorite dwarf, Garber.

Trees set in spring of 1895, now dead. Bartlett.

The dwarf Bartlett is the only variety that set fruit in 1899.

APRICOTS.

The following varieties of apricots were set in the spring of 1892 and are now living Golden Russian, Gibb, Alexander, J. L. Budd, Peach, Early Golden, Shemsi, New Castle, Luizet, Jackson, Olberg.

The following varieties have set fruit this year: Golden Russian, Gibb, Alexander, J. L. Budd, Peach, Early Golden, Jackson, Olberg.

The following varieties of apricots were set in the spring of 1892, but have died from various causes: Nicholas, Alexis, Roman.

Trees of the following varieties now measure more than 16 inches in circumference of trunk: Golden Russian, Gibb, Alexander, J. L. Budd.

PLUMS.

The following varieties of plums bloomed in 1899: Weaver, Newton, Wooten, Mrs. Clifford, Forest Garden, Lone Star, Emerson, Wolf's Free Stone, Pottawattomie, Botan, Satsuma, Yosebe, Ogon, Abundance, Burbank, German Prune, Manana, Silver Prune, Pissardii.

The following varieties of plums set fruit in 1899: Abundance, Emerson, Manana, Mrs. Clifford, Newton, Ogon, Pottawattomie, Pissardii, Weaver, Wooten, Yosebe.

Trees set in spring of 1895, trunk measuring more than 10 inches in circumference: Lone Star, Yosebe, Burbank.

Trees set in spring of 1895, trunk measuring between 8 and 10 inches in circumference: Shiro Snomo, Manana, Hattankio, Wooten, Mrs. Clifford, Emerson, Pottawattomie.

Trees set in the spring of 1895, trunk measuring between 6 and 8 inches in circumference: Weaver, Newton, Botan, Wolf's Free Stone, Satsuma, Abundance, Pissardii, Silver Prune.

Trees set in the spring of 1895, trunk measuring less than 6 inches in circumference: Ogon, Forest Garden.

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CHERRIES.

The following varieties of Cherries were set in spring of 1895: Early Richmond, English Morello, Belle De Choisy, Dye House, Montmorency, Olivet.

All of the trees measure between 9 and 11 inches in circumference of trunk. All of the varieties fruited this year.

NUT BEARING TREES.

The following list of nut trees was set in 1895. A few trees of each variety are still living, but none have borne any fruit. They are arranged in order of hardiness: Black Walnut, Almond Languedoc, Early Bearing Walnut, Dwarf Prolific English Walnut, English Walnut, Mayette Walnut, Thin Shelled Walnut.

The following list of nut trees was set at the same time and in the same plat with the above list, but none are now living: American Chestnut, Large Spanish Chestnut, Japan Chestnut, Extra Early Paper Shell Pecan, Select Texas Pecan, Butternut, White Filbert, Hazelnut.

PEACHES.

The following varieties of peaches set fruit in 1899: Alexander, Barnes, Becquetts Free, Bishop, Bell's October, Bonanza, Becquetts Cling, Champion, China Cling, Crimson Beauty, Cobbler, Druid Hill, Early York, Elberta, Gen. Taylor, Heath Cling, Henrietta, Indian Blood Cling, June Rose, Champion Mark, Mountain Rose, Old Mixon Cling, Ringgold, Sylphide, Salaway.

GRAPES.

In the following list of grapes the varieties are named in order of their relative hardiness and productiveness. The black grapes have shown the best varieties both as to hardiness and productiveness, the white next, and the red last. The best varieties of the white grapes are nearly if not quite as good as the best black grapes.

Black. Admiral, Hermann Jaeger, Elsmere, R. W. Munson, Concord, Cottage, W. B. Munson, Norton's Virginia, Mrs. Munson, Black Pearl, Dr. Warder, Clinton, Janesville, Devereux, Barry, Amanda, America, August Giant, Big Extra, Fern Munson, Carman, Ironclad, Israella, Isabella, Herbemont, Newman, Telegraph, Worden, Wilder, Rogers No. 2, Jacquez, Moore's Early, Highland, Cynthiana, Aminia, Cunningham, Early Wine, Elsinburgh, Hartford Prolific, Herbert, Beacon, Conqueror, Neva Munson, Neosho, Marion, Mary Ann, Montefiore, Rentz, Early Victor, Eumelan, Hermann, New Haven, Mills, Othello, Muench, Marguerite, Lenior, Louisiana, Merrimack, North Carolina, Peabody, Secretary, Whitehall, York Madeira, Cornucopia, Creveling, Bacchus, Black Hawk,

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Black Herbemont, Brant, Hopkins, Laussel, Jaeger, Oriole, Bailey, Black Eagle.

White. Faith, Elvira, Lady Washington, Martha, Noah, Pearl, Autuchon, Onderconk, Niagara, Wilding, Opal, Mason's Seedling, Moore's Diamond, Green Mountain, Gold Coin, Golden Gem, Empire State, Prentiss, Rommel, Grein's Golden, Hayes, Naomi, Humboldt, Jessica, Irving, Etta, Eva, El Dorado, Duchess, Uhland, Taylor, Pocklington, Transparent, Gov. Ross, Antoinette, Bell, Campbell, Centennial.

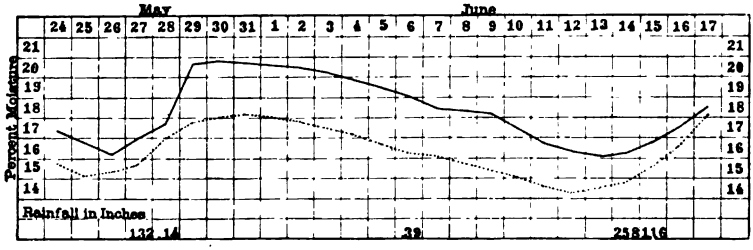
Red. Northern Muscadine, Dracut Amber, Perkins, Norfolk, Lutie, Wyoming Red, Catawba, Woodruff's Red, Brilliant, Amber, Amber Queen, Delaware, Goethe, Massasoit, Iona, Lindley, Ulster Prolific, Dr. Collier, Vergennes, Walter, Lindherbe, Venango, Diana, Beauty, Berckmans, Elvicand, Perry, Iowa Excelsior, Peter Wylie, Poughkeepsie, Requa, Challenge, Brighton.

CULTIVATION AND SOIL MOISTURE.

The station has studied the effect of cultivation on the moisture of the soil and issued two bulletins reporting the results obtained. These bulletins (Nos. 24 and 42) have been widely distributed and merit careful study. Only the briefest mention of the most striking results can be made here.

1. *Effect of manure and subsoiling.* Many farmers have had unfortunate experience with subsoiling and are prejudiced against it. Land that has been subsoiled absorbs moisture and parts with it more readily at first than ordinary soil. However, after the soil has had time to settle, that which has been subsoiled usually contains more moisture than soil not so treated.

One field was manured in the fall of 1895, subsoiled in the fall of 1896, and planted to corn in the spring of 1897. Another field was neither manured nor subsoiled and was planted to Kafir in the spring of 1897. Daily determinations of the moisture in the surface foot of the soil in each of these fields were made from May 24th to June 17th. The soil that had been manured and subsoiled



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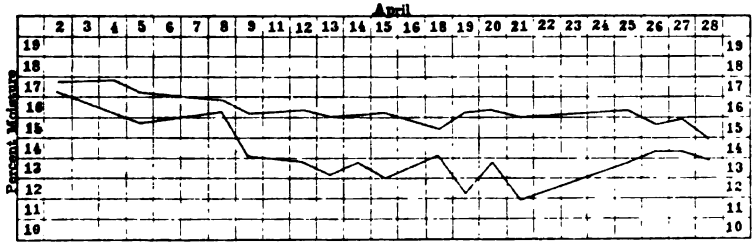
contained an average of two and one-half per cent. more water than the soil of the other field.

In the preceding chart, the upper line represents the daily determinations of moisture in the manured and subsoiled soil. The lower line shows the moisture in the soil of the field that was neither manured nor subsoiled.

2. *Time of plowing.* The value of plowing as a means of keeping moisture in the soil is not thoroughly appreciated. A difference of a few days in the time of plowing sometimes greatly influences the amount of water in a soil.

About the middle of June, '98 a part of a plat of ground was plowed immediately after harvesting the wheat crop. So far as could be seen there was no variation in the different parts of the plat at that time. One month later, the moisture was determined in both the plowed and the unplowed parts. The samples were taken within ten feet of each other and it was found that the plowed part contained 14.9 per cent of water and the unplowed part 10.9 per cent. The plowed land contained over one-third more water in the surface foot than the unplowed land.

The following chart shows a similar result, the upper line showing the moisture in the soil of a plat plowed April 3 and the lower line of another plowed April 11.



It should be borne in mind, however, that the time and amount of rainfall, which are uncontrollable factors, might greatly modify results in another trial.

3. *Effect of rolling.* The influence of rolling the soil has been studied and reported in the bulletins previously mentioned. In general, rolling the soil tends to draw the moisture to the surface and hasten germination of seed. This is accompanied, unless the compact surface is broken by harrowing or some other means, by a rapid loss of moisture. In several trials, land that had been rolled contained more moisture in the surface foot soon after rolling than land not so treated. Later, however, the unrolled land uniformly contained the most water. When practicable land should be harrowed soon after rolling.

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4. *Stirring the surface* of the soil to a depth of a few inches has the effect of checking evaporation. As soon as the surface soil becomes dry enough after a heavy rain, it should be cultivated and dried out to the depth of two to three inches, no matter whether there are any weeds to be killed or not. Light showers do not compact the surface and need not be followed by cultivation. The frequency of cultivation for a given crop varies with the season; so long as the surface of the soil is loose and mellow, evaporation proceeds but slowly and little cultivation is necessary unless there are weeds to be killed.

KEEPING UP FERTILITY.

(Adapted from Bulletin No. 32.)

1. *Summary.* The fertility of every soil has a limit. Each crop grown removes a portion of the elements of fertility and leaves the soil poorer. The staple crops of Oklahoma—wheat, oats, corn, Kafir, cotton, and castor beans—if properly managed will not quickly exhaust the soil. The portion of these crops that is sold, when intelligently handled, removes less plant-food than does that portion which is frequently wasted and which should be returned to the soil. General farming, the growing of a moderate acreage of each of many crops, is to be preferred to the growing of but one or two crops year after year. Stock-raising and feeding should be engaged in by every farmer who can possibly arrange to do so. Aside from the increased price thus secured for crops, this system of farming tends to keep the plant-food on the farm. Stable manure is a valuable agent for the improvement of our soils, and should in all cases be well cared for and spread on the fields, and not be regarded as a nuisance to be disposed of in the easiest possible manner.

2. *Introduction.* It should be the earnest endeavor of each owner of a farm to keep the original stock of fertility of the soil unimpaired, and, if possible, to so manage that an increase over previous yields will be secured rather than a continually diminishing return for the labor expended. That this may be accomplished, it is essential that the simpler facts of the chemistry of soils and crops be familiar to every one engaged in farming. The following pages have been prepared for the purpose of acquainting the farmers of Oklahoma with what is known along this line, and of showing the relation of our principal staple crops to the soil's fertility. The experience of the eastern part of the United States emphasizes the importance of this subject. The enormous sum paid annually for commercial fertilizers is, to a great extent, the penalty which must be paid for wasteful practices which were

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common when the "unbounded fertility" of the soil was never questioned.

3. *Plants.* Every plant, from the vilest weed to the most valuable crop that grows, is made up of essentially the same elementary sustances. Part of these substances is taken from the air and part from the soil. At present, for sake of clearness, no further reference will be made to that portion obtained from the air. More than a dozen different elements contained in plants are derived from the soil. It is needless for our present purpose to complicate matters by giving a list of them. All of them are essential to the production of plants and all are found in almost every soil.

4. *Soils.* Practically, every soil contains all of these substances, with three exceptions, in sufficient amounts for the production of maximum crops if the other conditions, such as water supply and mechanical condition, are right. This being the case, it is sufficient for our present purpose to consider only the exceptions.

The three substances frequently deficient in soil are nitrogen, potash, and phosphoric acid. These names have been assigned to certain substances that are present in, and essential to the growth of, all plants. If one is absent from a soil, the crop will not mature properly; if any one of them is present in a very limited quantity continually decreasing crops will be the result. Nitrogen, potash, and phosphoric acid collectively are called plant-food, a term which carries its meaning with it.

This plant-food exists in several forms in the soil; some of it is soluble, and consequently called available, because it is in a form to be taken up by plants. Other portions are insoluble and not ready for use, hence termed unavailable. The amount of available plant-food in a soil is the factor which determines its ability to produce a crop and the number of crops which it will produce. The available plant-food is slowly replenished from the isoluble portion, but at the same time it is being diminished by crops and by the leaching of the soil by heavy rains. This supply of plant-food is the stored-up energy of the farm. Different crops remove these three materials in different amounts, but each crop leaves the soil with a portion of its stored-up energy expended.

5. *Soil Analysis.* This being true, it would seem that a chemical analysis of a soil should tell exactly the amount of plant-food which it contained and afford a means of correctly estimating its crop-producing power. This, however, is not the case. The difficulty of securing representative samples, inability to determine the exact amount of available plant-food, and the impossibility of correctly forecasting the rate of change in availability of the plant-food, make a soil analysis of little direct, practical value to a

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farmer. Climatic conditions being favorable, the only true test of a soil's ability to produce a crop is a crop test.

On the other hand, a study of the amount of plant-food removed by different crops, and of the most profitable way of converting those crops into money, and still retaining their elements of fertility on the farm, is the true way for a farmer to conserve his capital. Leading toward this end, Oklahoma's staple crops have been studied and general plans of the way of disposing of them so as to reduce the loss of plant-food to a minimum, are given in the following pages.

6. *Wheat.* One thousand pounds of winter wheat contain 24 lbs. nitrogen, 6 lbs. potash and 9 lbs. phosphoric acid.

The straw harvested with this amount of grain will weigh approximately two thousand pounds, which contain 12 lbs. nitrogen, 10 lbs. potash and 3 lbs. phosphoric acid.

The grower of wheat has no option but to sell the grain. Present methods of disposing of the straw could be greatly improved. The straw is valuable not only on account of the plant-food which it contains but also on account of the large amount of organic matter. Many of our soils are hard and compact and would be greatly improved by plowing the wheat straw under, thus bettering their mechanical condition by making them take up water more readily and part with it by evaporation more reluctantly. The straw, instead of being burned or allowed to decay in one huge pile, should be hauled or dragged over the field, scattered about and plowed under. It is true that decomposition of straw takes place but slowly in this climate, but the little extra trouble in plowing will be repaid by the improvement of the soil which will result. Where headers are used, much of the straw is left in the fields, but that which is removed should nevertheless be returned to the soil.

The preceding remarks apply to farms almost exclusively devoted to raising wheat, and on which little stock is kept. On farms where a variety of crops is grown, the manure produced by bedding the stock in stables, as well as that which accumulates when cattle winter about the straw pile, should be hauled onto the fields and plowed under when the soil is being prepared for a subsequent crop.

7. *Oats.* One thousand pounds of oats contain 20 lbs. nitrogen, 12 lbs. potash and 16 lbs. phosphoric acid.

The straw harvested with this amount of grain will weigh approximately two thousand pounds, which contain 12 lbs. nitrogen, 25 lbs. potash and 4 lbs. phosphoric acid.

The grain may be either sold or fed on the farm. At prices which usually prevail, it pays better to pursue the former course and feed corn or Kafir.

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The remarks made concerning the disposal of wheat straw apply with equal force in regard to oat straw, with the exception that the latter contains a larger amount of plant-food and its return to the soil is even more important.

8. *Corn.* One thousand pounds of corn in the ear contain 14 lbs. nitrogen, 5 lbs. potash and 6 lbs. phosphoric acid.

Approximately six hundred pounds of corn stover will be produced along with this amount of corn. This weight of stover contains 6 lbs. nitrogen, 8 lbs. potash and 2 lbs. phosphoric acid.

By far the largest amount of corn grown in the Territory is husked from the standing stalks, which are left in the field and serve as winter pasture for cattle. It is, however, customary to drag off the stalks in the spring and burn them. This practice has its commendable features, as it is very difficult to get the soil in good condition when it is littered with corn stalks. Notwithstanding this, the practice is a wasteful one and should be resorted to as seldom as possible. All of the nitrogen is lost when anything is burned, as well as the organic matter in which many of our soils are deficient.

The disposal of the corn is accomplished in two principal ways, either by selling the crop direct, or by feeding it to cattle or hogs and selling them. From the standpoint of maintenance of fertility, the former method is undesirable. Better returns in money are usually secured and less depletion of the soil's resources takes place when the corn is fed to stock and the manure returned to the soil. When any crop is fed to stock, less than 25 per cent of the manurial value of the feed is carried off by the animals when they are sold. This being the case, farms where a sufficient number of animals is fed to consume the corn crop will, beyond question, be producing good crops of corn long after the farms from which the crop is sold every year have been abandoned.

9. *Kafir.* One thousand pounds of mature Kafir fodder (whole plant) contain 8 lbs. nitrogen, 22 lbs. potash and 9 lbs. phosphoric acid.

For sake of comparison, one thousand pounds of corn fodder contain 12 lbs. nitrogen, 9 lbs. potash and 6 lbs. phosphoric acid. This does not indicate a great difference in the effect of these crops on the soils.

Under present conditions, the bulk of Kafir grown is fed on the farm. This, as with corn, is the most desirable method of disposing of the crop.

10. *Cotton.* There is no other crop that will, if improperly managed, more certainly diminish the fertility of the soil. The impoverished soils of the old cotton-growing states are a more convincing argument in support of this proposition than any arrangement of the results of chemical analyses could possibly be.

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Yet it may serve a useful purpose for us to examine the composition of the cotton plant, that we may understand clearly why it is so exhausting to the soil and how to avoid this exhaustion.

One thousand pounds of ginned cotton contain 3½ lbs. nitrogen, 4½ lbs. potash and 1 lb. phosphoric acid.

With this amount of lint will be produced two thousand pounds of cottonseed, which contain 63 lbs. nitrogen, 23 lbs. potash and 25 lbs. phosphoric acid.

If nothing but the lint is sold, and the seed is in some way returned to the soil, but very little diminution of the soil's fertility will result, the lint containing but an insignificant amount of plant-food.

The seed, on the contrary, is a concentrated substance which contains a large amount of materials whose removal impoverishes the soil. Cottonseed may be disposed of in a variety of ways, chief among them being (a) selling for an absurdly low price to gins, where it is sometimes used for fuel, thus entailing an enormous waste of nitrogenous matter; (b) selling to oil mills, where the oil is extracted and the cottonseed meal shipped to northern markets, carrying with it the fertility of our soils; (c) feeding the seed to cattle, or exchanging it for cottonseed meal at the oil mill and feeding the meal.

Without losing sight of the fact that it is not always possible to do the best thing from an economic standpoint, it does seem that the lesson of the old states should not be lost on this new country. At times it may be necessary to sell the seed for what it will bring and use the proceeds for pressing necessities. This should, however, be the exception and not the customary method. The cotton-grower is very apt to become a "one-crop" man, and, if he does, the chances are that he will leave neither money nor a good farm to his children.

The general results of feeding experiments with cottonseed are that it may be fed with profit to steers in connection with our common forage plants, such as corn or Kafir stover. It is not considered safe to feed it to hogs, but bad results are not always experienced when hogs are allowed to run after steers that have been fed cottonseed. The building of oil mills should be encouraged and, when they are established, an exchange of cottonseed for cottonseed meal, which is the better feed, should be made instead of selling the seed. The meal is left after the extraction of most of the oil, and is an excellent feeding stuff in addition to its containing nearly all of the plant-food which was in the hulled seed. The feeding of cottonseed and its products to cattle by cotton-growers is the proper method of keeping up the fertility of our cotton-fields. Had this plan been followed by cotton-growers in the old South, they would not now be under

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the pressing burden of an enormous annual expenditure for commercial fertilizers.

11. *Castor Beans.* An extended study of the castor oil plant has been made. Since the leaves and stalks of this plant remain in the field, the plant-food which they contain returns in a great measure to the soil and need not enter into this discussion.

The portion which is gathered when the crop is harvested consists of the pods containing the beans, together with the stems of the spikes. This is later divided into two portions, which we have designated respectively as beans, the part which is sold; and pods, which remain on the farm. One hundred pounds of the dry, gathered spikes yield, as the average of our determinations, 55 lbs. of cleaned beans and 45 lbs. of pods. The features of this crop which deserve study are (a) the amount of plant-food sold with the beans and (b) the amount of plant-food contained in the pods and whether or not they are worth looking after.

One thousand pounds of castor beans contain 35 lbs, nitrogen, 4 lbs. potash and 14 lbs. phosphoric acid.

The pods gathered with this amount of beans weigh approximately eight hundred pounds and contain 13 lbs. nitrogen, 46 lbs. potash and 1½ lbs. phosphoric acid.

The beans themselves are not exceptionally "hard" on the soil, and a comparison of the money value of castor beans with that of an equal weight of other crops leads to the conclusion that it is desirable to grow them in preference to crops that require a large amount of expensive machinery to handle.

The pods contain an amount of plant-food of more value than that present in an equal weight of average wood ashes. The value of ashes as a fertilizer is well known and utilized by careful farmers. The pods of castor beans are fully as valuable and should be taken care of and returned to the soil. Their value as a manure, based upon what the plant-food in them would cost if purchased in the form of fertilizers, is over ten dollars per ton. This figure represents the extent to which the stored-up capital of the farm is drawn upon and wasted when this portion of the crop is not returned to the soil. The plant-food in the hulls is slowly available and their effect would be lasting. From their composition, they are well suited for the manuring of fruit trees and similar valuable crops. The pods cannot be sold for money, but they are a feature of this crop second only in importance to the beans, and should be put to good use and not be wasted.

12. *Alfalfa and Cow-Peas.* (See pp. 53-57.) The preceding comprise the principal crops that are grown for market. In this connection, the class of plants to which alfalfa and cow-peas belong should be mentioned. These two are the most promising leguminous plants for forage in this climate. They differ from the crops

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previously mentioned in that they possess the power of securing from the air a portion of the nitrogen which their growth requires. Thus, when grown and fed on the farm, they increase rather than diminish the stock of fertility in the soil. When cow-peas are plowed under, not only is the mechanical condition of the soil improved, but there is an increase in the store of plant-food available for subsequent crops. The same is true of alfalfa, whether it is pastured or cut for hay and fed on the farm, the manure being returned to the soil.

ANALYSES OF WATERS.

The character of the water supply has so much to do with the health of any community that it merits great attention. The chief factors which determine whether or not a given water is fit to drink are the quantity and character of the dissolved mineral matter which it contains and the nature and source of the organic matter. The mineral matter depends on the character of soil through which the water percolates before it is drawn for use. The amount and character of the organic matter is to a great extent, affected by local contaminating influences.

1. *Mineral matter.* More or less complete analyses have been made of the mineral matter contained in 162 samples of water. The samples secured represent nearly every county and condition of soil. Further work has not given cause to change the following statement made in Bulletin 29, September, 1897. "It may be said, in general, that good water is obtainable in almost every part of Oklahoma. There are a few localities where more or less difficulty is experienced, but care in digging the well is frequently repaid by a supply, small at times, of good water. The mistake of going deeper for more water is sometimes made with the result that it is secured but that the whole supply is unfit for use. If the first water struck is good, and there is a fair amount of it, digging should be stopped, especially in localities where bad water is frequent. A second well may be dug if the supply is insufficient."

2. *Organic matter.* Epidemics of typhoid fever are frequently traceable to organic contamination of the water supply and this contamination is usually due to carelessness which no amount of analyzing the water will remedy. Attention was called to this in an early Bulletin (No. 7, July, 1893) and the following advice concerning location of wells was published. "Do not invite pollution by locating a well near a cess-pool or barnyard. I found a few wells very poorly walled and some very badly located, and in one or two instances the location could not have been worse had the question been carefully studied. Those of you who have not

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permanently located your buildings would do well to first find a supply of good water—I believe it can be obtained—then build near the water." "Should the water have a disagreeable smell after having been kept in either an open or closed vessel any considerable length of time, something is radically wrong and the source of pollution should be immediately looked up and removed without delay."

The importance of keeping the water of wells and springs free from organic contamination cannot be too strongly urged as it is from this source that much sickness comes. Insects, toads, mice, rats, and rabbits have a way of getting into wells that is at times past finding out but they can be kept out by properly curbing and covering the well. No amount of covering will prevent drainage from getting into the well which should in all cases be at least 100 feet from, and on higher ground than, any possible source of refuse from the house or barn.

3. *Waters for irrigation.* Much work has been done on this subject and two bulletins have been issued. The following summary from Bulletin No. 38 gives the conclusions which have been reached:

"1. The water of the Salt Fork of the Arkansas and of the Cimarron river is unfit to be used for irrigation except in very limited amounts.

"2. The water of the North Canadian and of the South Canadian may be safely used for irrigation.

"3. None of the smaller streams that have been examined, except the Black Bear, are unfit to be used for irrigation.

"4. Well waters vary greatly in the amount and character of the dissolved mineral matters which they contain and should be analyzed before being arranged to be used for irrigation.

"5. A partial survey of the conditions which must be met in the construction of reservoirs for the retention of storm river waters has been made and it is not clear that this method is entirely feasible in all cases."

Correspondence should always be had with the station before sending samples for analysis as certain precautions in sampling must be observed to make the results trustworthy.

FEEDING CORN AND KAFIR.

1. *Introduction.* The general trend of results of feeding trials with Kafir products is that it requires more Kafir than it does of Indian corn to produce a pound of live-weight. In an experiment with pigs at the Kansas Station (Bul. 53.) it was found that 5.15 lbs. red Kafir meal were required to produce a pound of gain while 4.38 lbs. corn meal gave the same result. In each case, the pigs

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were given all they would eat and while those fed Kafir meal gained 1.37 lbs. per day, those fed on corn meal gained 1.7 lbs.

Another trial at the same station (Bul. 61) gave even more marked results in favor of corn meal, 3.96 lbs. of which gave a pound of gain against 6.21 lbs. of Kafir meal. The pigs fed corn meal made an average daily gain of 1.44 lbs. while those fed Kafir meal gained but one-half pound per day. An experiment in fattening heifers is also reported in the same bulletin. It is concluded "that red Kafir corn meal is not quite equal to corn meal for fattening cattle, though the difference in favor of corn is less marked than in the case of the hogs."

In another trial at the Kansas Station (Bul. 67) three lots of steers were fed corn meal, red Kafir meal, and white Kafir meal, respectively, making daily gains of 1.86 lbs., 1.71 lbs., and 1.78 lbs. per head. To produce a pound of gain in weight it required 9.97 lbs. of corn meal, 10.86 lbs red Kafir meal, or 10.41 lbs white Kafir meal. The profit from the five steers fed corn meal was $47.60; from the five fed red Kafir meal, $44.98; from the five fed white Kafir meal, $42.02. Hogs followed the steers during the experiment and made gains which bring the profit from the feeding of corn meal up to $54.70; red Kafir meal to $55.10; and white Kafir meal to $53.23, "which practically places Kafir corn on the same basis as corn in regard to feeding value."

Practical feeding experiments have been conducted at this station, the results of which will be found on pp. 18 to 32.

In view of the increasing importance of Kafir in this and similar regions, it is necessary that a definite system of nomenclature be used when speaking and writing of the crop. The following, based principally on current usage among farmers, is used in this report:

Kafir, the crop in general.
Kafir corn, thrashed grain.
Kafir heads, portion bearing grain.
Kafir fodder, whole plant above ground.
Kafir stover, Kafir fodder minus the heads or grain.
Kafir meal, ground Kafir corn.

2. *Digestion experiments.* After a crop has been found to yield well and grow readily, it is most desirable to have a correct estimate of its value. Chemical analyses alone will not furnish a correct basis for this estimate. Feeding trials in comparison with a crop of known value are practical experiments but are much influenced by the conditions of the experiments. These two, however, in connection with trials of the digestibility of the feeding stuff in question, aid in determining to a great extent the value which should be attached to a crop. With this purpose in view, several digestion trials have been conducted by the station.

In a digestion trial, weighed quantities of feed are given to

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animals (usually steers or sheep) and the dung is collected and weighed. Both the feed and the dung are analyzed and from these data the per cent. of food digested is determined.

Twenty-two separate trials were made with Kafir products fed to steers. The complete details of the experiment were reported in Bulletin No. 37. The essential results of the experiment may be summarized as follows:

Kafir stover contained as much digestible matter as average corn stover.

Kafir fodder contained 10 per cent. less digestible matter than average corn fodder.

Kafir heads contained one-third as much digestible matter as average corn-and-cob-meal.

Kafir corn fed in the heads was neither more nor less digestible than when fed after thrashing.

Kafir corn fed after soaking in water for twelve hours was less digestible than when fed dry.

Kafir corn fed dry contained 40 per cent. less digestible matter than coarsely ground Kafir meal.

Kafir meal, coarsely ground, contained 20 per cent. less digestible matter than average corn meal.

It paid to grind Kafir corn—One hundred pounds of Kafir meal contained as much digestible matter as one hundred and sixty-seven pounds of Kafir corn.

A gain of thirteen per cent. in the amount of digestible matter was secured when Kafir fodder was thrashed, the grain ground and fed to steers along with the shredded stover from the fodder.

A gain of less than two per cent. in the amount of digestible matter was secured when Kafir fodder was thrashed, and the resulting Kafir corn fed to steers along with the shredded stover from the fodder.

DIGESTION OF KAFIR CORN BY STEERS.

The following comparison of the composition of Kafir corn before and after having passed through the digestive tract of steers shows the slight extent to which the small, hard grains are affected during the process.

Composition of Kafir corn.

	Water-free substance.				
	Ash.	Protein	Fiber	N-free ex.	Ether ex.
As fed dry.. ... .1.30		12.72	1.82	81.00	3.16
After digestion, A.....0.83		11.73	1.65	82.34	3.45
B.....0.81		13.60	1.76	80.78	3.05
C.....0.85		12.54	1.69	82.00	2.92
D.....0.74		11.04	1.74	83.95	2.53
Average, A, B, C, & D.0.81		12.23	1.71	82.26	2.99

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	Water-free substance.				
	Ash.	Protein	Fiber	N-free ex.	Ether ex.
As fed soaked	1.37	13.11	1.88	80.13	3.51
After digestion, A	0.78	12.85	2.24	80.73	3.40
B	0.77	12.49	1.70	81.51	3.53
Average, A & B	0.78	12.67	1.97	81.11	3.47

Calculated to organic matter, we have the following composition for Kafir corn fed dry, before and after digestion:

	As fed.	After digestion.	Difference.
Protein	12.88	12.33	—.55
Fiber	1.84	1.72	—.12
Nitrogen-free extract	82.08	82.94	.86
Ether extract	3.20	3.01	—.19

In the same manner, the organic matter of Kafir corn after soaking for 12 hours has the following composition, before and after digestion:

	As fed.	After digestion.	Difference.
Protein	13.32	12.77	—.55
Fiber	1.91	1.98	.07
Nitrogen-free extract	81.21	81.76	.55
Ether extract	3.56	3.49	—.07

TEXAS FEVER.

The importance of the cattle industry in the territory and the inconvenience and loss that are caused by necessary quarantine regulations have led to a large amount of work by the station in its endeavor to aid in securing a thorough knowledge of Texas fever. In May of this year, Bulletin No. 39 was issued and contained an account of the dipping experiments conducted at Noble by the station and of trials of inoculation as a possible means of prevention of the disease. The general features of the disease were described in Bulletin No. 27 issued in July, 1897. Copies of these bulletins will be sent to those interested so long as the supply lasts.

The following from Bulletin No. 39 sums up the Texas fever situation and the results of experiments conducted by the station:

Northern cattle may be brought south with safety if they are placed on pastures free from infection. Calves may be shipped south under any conditions with more safety than mature cattle, and stock breeders may get well bred animals from southern herds without any danger of losing the cattle from Texas fever.

The dynamo oil used in the dipping experiments is absolutely destructive to the cattle tick and can be used under proper conditions with little danger to cattle. Dipping in this oil late in the fall or during winter is not advisable. A sample of oil from the

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National Refining Co. of Cleveland, Ohio, was tried on ticks and animals. It has a less irritating effect on the skin and is equally as effective in killing the ticks as the dynamo oil.

Keeping defibrinated blood of a southern animal for a great length of time seems to lessen its virulence so that it causes a mild attack of the fever. This was tried on only two animals and no positive conclusions can be drawn from this amount of work.

The old theory that Texas fever is communicated by sore or feverish feet or by the saliva has outgrown its usefulness. It is never considered by those who have studied the disease experimentally, or by stockmen who have informed themselves in regard to the work done, and then observed the course of the disease and the means of infection on stock ranches. The so-called "tick theory" is no longer a theory but a fact, and the national quarantine line is located with reference to the distribution of the cattle tick, and this only. The only object in enforceing the quarantine against southern cattle during the time they are infected with the tick is to prevent losses among cattle susceptible to this disease. The old theories of infection by means of the feet, or by the saliva have received as careful attention from experimenters as any theories could receive, but were completely disproved in every experiment, while infection by ticks has always produced the disease in a recognizable form.

The actual cause operating in the body and which produces the disease is a very minute parasite or one-celled animal which lives in, and soon destroys, the red blood corpuscles. In the acute form of the disease, more than one-half of the red corpuscles may be destroyed in a few days, thus producing the thin, watery condition of the blood so noticeable on post mortem examination. This organism which causes the disease is conveyed from southern cattle to susceptible cattle by means of the cattle tick. The one means at hand to prevent the communication of the disease is by preventing the transference of cattle ticks. Killing the ticks by dipping the cattle in oil, with the proper precautions, or by applying oil with a brush to infected animals, or by picking the ticks off and destroying, are methods for the prevention of the spread of the disease.

Medical treatment is usually not very successful unless the disease is recognized in its earliest stages. The destruction of the red corpuscles of the blood has been going on for some time before the symptoms become well marked and the remedies used at this time give little beneficial results. The bowels should be opened by giving one quart of raw linseed oil, or one pound of salts for an adult animal. Quinine is frequently beneficial in doses of two to four drachms three times daily.

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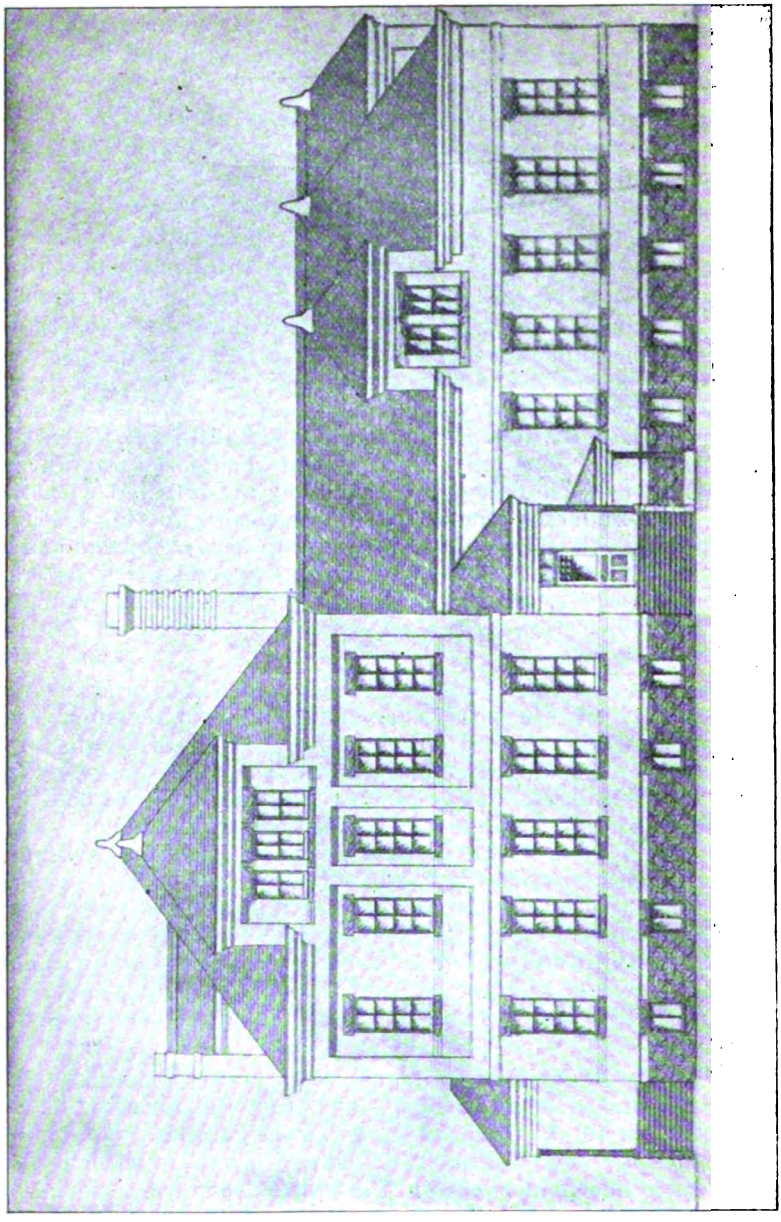

EAST ELEVATION OF CHEMISTRY BUILDING. (In course of erection.)

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WEEDS.

Two bulletins have been issued by the station describing the commonest and most troublesome weeds. The demand for these bulletins has exhausted the supply and both are now out of print. There seems to be an impression that each weed requires some sort of special treatment to eradicate and destroy it. Inquiries about weeds are numerous. They are nearly all answered in the following remarks taken from Bulletin No. 41.

"It may be stated in general that the principle upon which to work in the eradication of weeds is to prevent growth and propagation. In the case of annuals and biennials, growth is in most cases destroyed if propagation is prevented; example, purslane. With some species where the same individual lives for more than two years, propagation may be prevented and still the original plant become stronger thereby; example, bindweed. If the energy of the plant is not employed in producing seed, it has the more left for foliage and consequently for increasing the store of food in the roots; example, perennial ragweed. The young shoots from perennial deep-rooted plants are produced at the expense of the material stored in the roots until these young shoots produce foliage with which to gather nourishment from the air to replenish the subterranean storehouse and also produce seed. Therefore it is easy to see that if perennial plants are prevented from forming foliage they must in time be starved out. It would often appear that this is not the case, but the conclusion is reached that the shoots have been destroyed but once or twice or the work has not been done thoroughly enough to prevent the formation of foliage from a shoot already formed.

"Too many farmers in the territory are neglecting the weed question. The rich new soil is not very foul until crops have been grown for a few years. By various agents the seeds are distributed through the cultivated field and those plants that are well adapted to escape destruction in the cultivation of crops continue to grow and reproduce. Into this class fall the passion vine of the low grounds and the perennial ragweed of the uplands.

"Another common source of infection is the highways. Many of the highways of the territory have never been graded at all. One track is used until it is worn and washed too deep to be safe, and then a new one is taken. In most places where the native grasses have not possession of the soil, rank weeds grow up unless the soil is continually washed away. The seeds from these are not only scattered along the highways by animals and vehicles, but are carried by the winds far over the fields. Much can be done towards preventing this distribution by expending a comparatively small amount of labor on wayside weeds. The writer has driven several hundred miles in the territory, and yet no instance is recalled of

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having observed any cutting of weeds along the public highways, although in many places they stood ten feet high.

"While Oklahoma is a good place for the luxurious growth of weeds the long, hot, dry days are excellent times for killing them. The practice of every farmer in the territory is not to be condemned, for often large fields of forty acres or more are seen almost entirely free from weeds of any kind."

Briefly, the way to kill any weed that grows is by killing it. The manner of doing this must be varied slightly to suit the kind of weed but if any of them are plowed and cultivated and scraped and hoed up persistently, they will soon die.

SHADE TREES.

The planting of shade trees for the production of timber as well as for their beauty should receive large attention. Many lessons might be drawn from the experience, not always fortunate, of the station. The most important, however, is the influence of continued clean cultivation on the growth and general vigor of trees. The accompanying illustration shows two rows of maples that were set out in the spring of 1892 and at that time, had an equal chance for making successful growth. The row of small trees was close to the fence and received only partial cultivation. The larger trees in the illustration received thorough cultivation, the land being kept free from weeds and grass for a space of at least a rod on each side of the row. But few trees fail to make good growth if they are set out in large enough holes and given clean cultivation from the start. Holes three feet in diameter and three feet deep are none too large, the hole being filled in to the proper depth with surface soil before setting the tree.

The division of forestry of the U. S. Department of agriculture has started experiments in the growing of forest trees on the station grounds. In April, 1898, trees one year old from cuttings were set out as indicated in the accompanying table, four feet apart each way. They were given clean cultivation but no pruning

KIND OF TREE.	No. Set in April, 1898.	No. Alive in Nov., 1898.	Per Cent Died During Summer, 1898.	No. Alive June 1, 1899.	Per Cent Died During Winter, 1898-99.	Per Cent Surviving 14 months.
Catalpa	1599	1497	6.4	1482	1.0	92.7
Red (soft) Maple	2558	1321	48.4	1280	3.1	50.0
Silver Maple	1500	1060	29.3	1017	4.1	67.8
White Elm	1500	1176	21.6	1155	1.8	77.0
White Ash	320	290	8.1	289	0.3	90.0
Black Cherry	270	228	15.5	224	1.8	82.9
Black Birch	511	123	75.9	118	4.1	23.1
Black Locust	333	256	23.1	247	3.5	74.1

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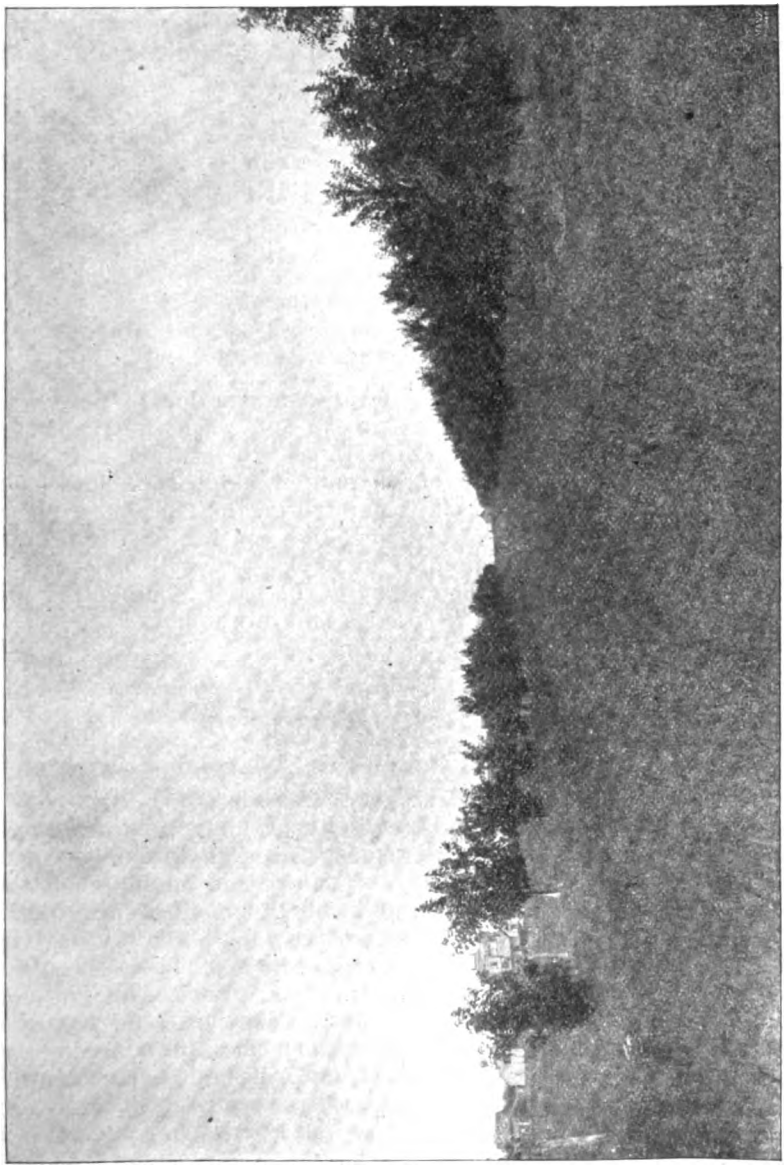

Not cultivated. MAPLES. Cultivated.

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or other attention. The accompanying results give some indication of the relative hardiness of the different trees included in the list but are not in any sense to be regarded as final.

The following summarizes the record of seedlings from planting in April, 1898.

KIND OF TREE.	No. Alive in Nov., 1898.	No. Alive in May, 1899.	Per Cent Surviving Winter, 1898-99.
Walnut (black).....	258	243	94.2
Pecan.	465	124	26.7
Bur Oak	150	133	88.7
Bur and Red Oak.....	411	403	98.1

BORERS IN TREES.

There are a number of plans for the prevention of borers in trees. Many use a strong solution of lye and wash the trunks of the trees with it and find it works well. At the station, soft soap mixed with a strong solution of common washing soda has been used with success. If this wash is painted on the trees on a clear, warm day, it will leave a thin, varnish-like coating on the trunks which will stay there for a number of weeks, and will prevent the female beetles from laying their eggs on the bark. The borers are grubs of beetles which hatch from eggs laid on the bark.

BORDEAUX MIXTURE.

The following from Press Bulletin No. 38 explains the manner of making and using the effective insecticide:

"Every fruit grower should own a spraying apparatus and should apply Bordeaux mixture once before the blossoms open, second time just as the flowers are opening, and again when the apples are about the size of peas and a fourth and fifth spraying at intervals of about three weeks thereafter. This should prevent apple scab and fungi that attack the foliage. The 50 gallon formula for Bordeaux mixture is as follows: Water, 50 gallons; blue stone, 6 lbs.; unslacked lime, 4 lbs. Take one head out of a 50 gallon barrel and fill half full of water. Tie up six pounds of blue stone in a piece of gunny-sacking and suspend it from a stick across the top of the barrel. In another vessel, slack 4 lbs. of lime to a smooth paste free from lumps and grit. When the smooth paste is obtained, add enough water to make 25 gallons. This is called milk of lime and must be well stirred before using. It will be found very convenient to cut a 50 gallon barrel in two, making

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two 25 gallon tubs. Having a 50 gallon barrel empty, each of two persons should take a bucket and into the barrel, one should pour milk of lime while at the same time, the other pours the blue stone solution. When all is mixed thoroughly, a steel knife blade should be held in the solution for one minute and then examined. If the steel takes on a copper color, more lime must be added but if it does not the preparation is ready for use."

KILLING INSECTS IN STORED GRAIN.

Wheat stored in warehouses, elevators, and granaries is frequently attacked and injured by insects. They may be killed by an application of the fumes of carbon bi-sulphide which is a colorless liquid with strong odor and evaporates freely at ordinary temperature. The vapor of it is heavier that air, is highly explosive and a strong poison when taken in large amounts. Fire should never be brought within 100 ft. of where it is being used.

In using it, cover the grain with canvas or blankets after having placed in open, shallow dishes on the grain, one-half pound of the bi-sulphide for each 100 bushels of grain. The grain should remain covered for twenty-four hours when the liquid will have evaporated and permeated the grain killing the insects. A second treatment may be required when the grain is stored in large bodies. The carbon bi-sulphide in 50 lb. cans costs about 10 cents per lb.

DAIRYING.

The dairy interests of Oklahoma are not extensive when compared with those of states farther north where large amounts of capital are invested in dairy herds, creameries and private dairies. The aggregate number of cows, however, is large and their product is of considerable value and may easily be made more valuable. The little herd on each farm may be made to yield a product which will pay for a large share of the living expenses of the family. In many cases, partly due to lack of facilities and largely due to careless methods, it does not do so now. Much of the butter which is brought to the towns is of poor quality, useless, and brings a very low price. The cost of making a pound of poor butter is about the same as the cost of making a pound of good butter and there is great room for improvement.

The object of this article is to call attention to the advances in dairy knowledge and practices which have been made in recent years, mainly due to the efforts of Experiment Stations in states where dairying is a chief industry. The results of this work are

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available to everyone at small cost. The U. S. Department of Agriculture has issued three Farmers' Bulletins which tell in a practical way how to care for milk on the farm and get the greatest returns from it. They are as follows and are sent free to all applicants: Facts About Milk; Butter Making on the Farm; and Care of Milk on the Farm.

The chief factors in the making of good butter are care and cleanliness at every stage of the operation. While expensive appliances make the work easier, it is possible with the ordinary pails and crocks and churns to make excellent butter. All vessels should be thoroughly scalded each time before they are used and then allowed to stand in the sun to dry. Milking should be done in a clean yard or stable and care taken that no dirt finds its way into the pail. The milk should be strained at once through either a wire screen or cotton cloth and set aside in vessels that have been thoroughly cleansed and scalded. The temperature while the cream is rising should be kept as low as possible but the cellar, room, or cave in which the milk is kept should be well ventilated and not have a musty odor. A high temperature is less injurious than a badly tainted atmosphere.

After the cream has risen, it should be skimmed, taking as little milk with it as possible. The cream from successive skimmings should be thoroughly mixed and allowed to "ripen," that is, to develope the odor of good butter. It is a difficult matter to determine just when the cream is in proper condition for churning but from taste and odor, one can judge with reasonable accuracy. Much cream is kept too long before churning. One to two, and at most three days during the warm season will develop the proper degree of sourness in the cream which, if kept longer, will begin to decompose.

After churning, the butter should be worked and salted, packed in crocks or made into rolls, and sold as soon as possible. In every town there are many families that would be willing to pay five cents a pound extra for good butter. The amount and character of the dirt in much of the butter which is to be had in stores is appalling. Butter bought from farmers has been found to contain chunks of salt, pieces of wood and other inconceivable impurities. Much of it was not worked properly, some of it was worked until it was like oil.

It is not possible for all to have nicely equipped dairies and everything most conveniently arranged. It is possible, however, for all to learn of the improved methods which are applicable on every farm and above all, to keep the utensils clean and sweet.

In the matter of feeding cows for milk and butter, there is room for improvement. J. H. Bone, formerly Associate Agricultur-

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ist of the station, thus sums up a comparison of the effect of alfalfa and blue-stem pasture.

"It is a popular opinion among those that handle cows that a change in feed causes a change in the richness of the milk. If cows are turned on pasture after being fed dry feed, the milk flow is increased and the conclusion is reached that the milk is not so good and does not contain so much butter fat for the same quantity of milk. This point has been studied at different experiment stations and but little difference found. It is usually the breed that makes the difference, or the condition of the cow and not the change in the character of the feed.

"An experiment to determine this point was conducted during May and a part of June, 1898. Two cows were pasturing on alfalfa at the time the experiment began. The weight of their milk was taken for one week and the milk was analyzed for solids and butter fat. Then the cows were turned on Bluestem, or ordinary prairie pasture, and their milk was weighed and sampled. Taking into consideration only the last week on prairie pasture, we find that there was only a slight difference in butter fat in favor of alfalfa in one case and none at all in the other. The same was true of the solids. The difference in milk yield was marked. One cow gave 5.6 pounds per day, or 22.4 per cent. less on bluestem than on alfalfa. The other gave 5 lbs. per day, or 20.2 per cent. less."

This experiment only confirmed the general results of experiments conducted on a larger scale elsewhere. The decreased production of milk, and consequently, of butter was caused by the change in the character of the feed from one which contained the nutrients necessary for the production of large amounts of milk to one which was deficient in these nutrients.

The science of feeding for the production of milk and butter has made rapid advances and requires much study in order to become thoroughly acquainted with all of the details. There are, however, a few simple principles which are easily understood by every one. Milk is a nitrogenous food and requires for its production a feed which contains a proper proportion of protein. Stating it more simply, a cow that is fed alfalfa, cowpeas, soy beans, clover hay, or similar feed, will give more milk than when she is fed on prairie hay, corn or Kafir fodder, or sorghum. The last named do not contain enough of the material which is required to make large quantities of milk. If cows being fed the last named are given some cottonseed, or bran, or pea meal, the total ration which they then receive is more like that when they are fed alfalfa and as a result, they give more milk. A ration consisting only of corn fodder with an accidental addition of a little corn occasionally does not contain the proper material for the production of milk

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and as a result, the best of cows will not do well when fed in this manner.

The same general remarks about feeding apply to young, growing stock on the farm. They are building bone and muscle and should have some muscle-making food. While corn and Kafir are the greatest of fattening foods, they are not suited for the ration of growing animals of any sort. Cowpea and alfalfa hay should be largely fed to young stock.

A number of creameries have been established within the past few years and some of them are meeting with good success. In some cases, the first cost of the creamery was unnecessarily large and some useless machinery was purchased. Before listening to a proposition to start a co-operative creamery in any community, the farmers should hold a meeting and arrange with the experiment station to have one of the members of its staff explain the workings of a creamery from a disinterested standpoint. A little foresight at the time of the organization of the company will prevent much dissatisfaction and loss later. The following from Press Bulletin No. 46 sums up the important points to be considered in starting a creamery:

"The Oklahoma community which pays $4,000 or more for a creamery building and outfit is needlessly spending money and making dividends improbable. The community which depends on 'creamery promoters' to 'work up an interest,' secure subscriptions, fix prices, is paying others to do at high pay what should be done by persons in the vicinity.

"Either of several well established, reputable firms will furnish plans and equipment for starting a creamery adapted for almost any Oklahoma community so the total cost need not be more than $2,000, and $2,500 should give a plant sufficient for the present needs of any creamery in the territory. Additions to building or machinery can readily be made.

"Unless the milk of 150 cows can be furnished, it would not be wise to establish a creamery. It would be much better if a minimum of 200 cows could be counted on. A visit by one or two intelligent men to successful creameries will be helpful. A well considered plan for managing the business, formally agreed to by all directly interested, and some direct money payments by each, will be helps to success. A competent, well trained butter maker should be employed. Better pay such a man a good salary than pay travelling agent 'promoters.'"

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BULLETINS.

The following bulletins have been issued since the organization of the station and to a great extent are summarized in the publication in which this appears. Copies of bulletins issued since July, 1897 will be sent in response to request so long as the supply lasts.

No. 1, Dec. 1891—General information, organization, and history.

No. 2, Mar. 1892—Record of progress and details of plans.

No. 3, June, 1892—Station notes, insects.

No. 4, Oct. 1892—Tests of varieties; oats, corn, spring wheat, Irish and sweet potatoes.

No. 5, Jan. 1893—Some soil analyses.

No. 6, May, 1893—Notes of progress; analyses.

No. 7, July, 1893—Water analyses.

No. 8, Oct. 1893—Tests of varieties of wheat.

No. 9, Jan. 1894—Tests of varieties of vegetables, 1893.

No. 10, Apr. 1894—Corn—report of experiments.

No. 11, July, 1894—Press bulletin excerpts.

No. 12, Sept. 1894—Wheat—report of experiments.

No. 13, Dec. 1894—Wheat feeding.

No. 14, Jan. 1895—Grapes, 1894.

No. 15, Feb. 1895—Garden vegetables, 1894.

No. 16, Mar. 1895—Oats—report of experiments.

No. 17, Dec. 1895—Oklahoma weeds.

No. 18, Apr. 1896—Irrigation for Oklahoma.

No. 19, Apr. 1896—Methods of destroying chinch bugs.

No. 20, June, 1896—Wheat experiments, 1895-6; Food value of corn scorched by hot winds; Fruit culture in Oklahoma; Peach rosette; The melon louse.

No. 21, Sept. 1896—Experiments in corn culture, 1896; Road making and repairing.

No. 22, Jan. 1897—Climate and crops in Oklahoma; Field experiments with Kafir corn.

No. 23, Feb. 1897—Cotton culture in Oklahoma.

No. 24, May, 1897—Oklahoma soil studies.

No. 25, June, 1897—Loss by exposure of corn stover and teosinte; Composition of pie melon; Fertilizer analyses of castor bean plant.

No. 26, June, 1897—Some insects injurious to orchards.

No. 27, June, 1897—Glanders, Texas fever, and symptomatic anthrax.

No. 28, June, 1897—Experiments with wheat, 1896-7.

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No. 29, Sept. 1897—Study of waters for irrigation; the irrigation plant.

No. 30, Jan. 1898—Oklahoma weather and crops for 1897.

No. 31, Feb. 1898—Strawberries; grapes; stimulating and holding fruit buds.

No. 32, Mar. 1898—Practical chemistry of soils and crops; study of the castor oil plant.

No. 33, Mar. 1898—Experiments with field crops, 1897.

No. 34, May, 1898—The San Jose scale in Oklahoma.

No. 35, Nov. 1898—Summary of digestion experiments with Kafir; Notes on feeding experiments.

No. 36, Nov. 1898—Summary of experiments with corn and wheat, 1898.

No. 37, Apr. 1899—Digestion experiments and fodder analyses.

No. 38, Apr. 1899—Analyses of waters for irrigation.

No. 39, May, 1899—Texas fever.

No. 40, May, 1899—Bacteriology of milk.

No. 41, May, 1899—Weeds of Oklahoma.

No. 42, June, 1899—Oklahoma soil studies.

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GRASSES.

Native and Introduced Grasses found near Stillwater, Oklahoma.

J. H. Bone.

COMMON NAME	SCIENTIFIC NAME	Period of Growth	Date of Blooming
Texas Blue Grass..	Poa arichnifera.....	March to June.....	April 8 to 15.....
	Panicum scr...neranium....	March to June.....	May 1 to 5.....
Wild Barley.....	Hordeum pusillum.....	March to June.....	May 1 to 5.....
Canary Grass.....	Phalaris caroliniana.....	March to June.....	May 5 to 10.....
Floating Foxtail...	Alopecurus geniculatus....	April and May....	April 25 to May 5.
Fescue.....	Festuca octoflora.....	April and May....	May 1 to 7.....
Cheat.....	Bromus ciliatus purgans..	April to June.....	May 10 to 15.....
Cheat.....	Bromus secalinus.....	April to June.....	May 10 to 15.....
Early Bunch.....	Eatonia obtusa.....	April to June.....	May 5 to 10.....
Buffalo Grass.....	Bulbilis dactyloides.....	April to October..	May 1 to 15.....
Couch Grass.....	Agropyron spicatum.....	April to July.....	May 20 to 25.....
Windmill Grass....	Chloris verticillata.....	May to July.....	May 20 to 25.....
Spike Grass.....	Distychlis spicatum.....	May to August...	May 10 to 15.....
Wild Rye Grass...	Elymus canadensis.....	May, June.....	May 15 to 20.....
Texan Crab Grass	Schedonnardus paniculatus	May, July.....	May 20 to 25.....
Florida Paspalum.	Paspalum floridanum glabratum.....	July to September	May 25 to 30.....
Slender Paspalum..	Paspalum setaceum ciliatiforum.....	July to September	May 25 to 30.....
Tickle Grass.....	Eragrostis pectinaceae.....	May to August...	May 25 to June 1..
Barnyard Grass....	Panicum crus-galli.....	May to September	May 25 to June 1..
Silver Beard Grass	Andropogon saccharoides torreyanus.....	April to August...	May 25 to 30.....
Stink Grass.....	Eragrostis major.....	May to August...	May 30 to June 5..
Green Foxtail.....	Chatechloa viridis.....	May to August...	May 25 to June 1..
Foxtail.....	Chatechloa laevigata.....		June 1 to 5.....
Sporobolus.....	Sporobolus cryptandus.....	June to August...	June 5 to 10.....
Sporobolus.....	Sporobolus argutus.....	June to August...	June 5 to 10.....
Tickle Grass.....	Panicum divergens.....	May to July.....	June 5 to 10.....
Crab Grass.....	Panicum sanguinale.....	May to October...	May 30 to June 10
Side-oats Grama...	Bouteloua curtipendula....	May to September	June 5 to 10.....
White Grama.....	Bouteloua oligastachya....	May to September	June 10 to 20.....
	Chloris elegans.....	June to August...	June 5 to 15.....
Mat Grass.....	Rottboellia cylindric...a...	May to July.....	June 5 to 15.....
Broad-leaved Spike Grass.....	Unolia latifolia.....	June to September	June 20 to 30.....
	Erichloa punctata.....	June to August...	June 5 to 15.....
	Panicum capillare.....	May to September	June 20 to 25.....
Needle Grass.....	Aristida oligantha.....	June to August...	June 20 to 30.....
Bur Grass.....	Cenchrus tribuloides.....	June to October..	July 1 to 5.....
Switch Grass.....	Panicum virgatum.....	June to September	July 1 to 10.....
Big Blue Stem.....	Andropogon furcatus.....	June to September	July 15 to 20.....
	Triolda stricta.....	July to October...	July 20 to 25.....
Little Blue Stem..	Andropogan scoparius.....	May to September	July 20 to 25.....
Nimble Will.....	Muhlenbergia diffusa.....	May to September	August 1 to 10.....
Mexican Drop-seed	Muhlenbergia mexicana...	May to September	August 1 to 10.....
Wild Timothy.....	Muhlenbergia racemosa...		August 1 to 10.....
Sprouting Crab.....	Panicum proliferum.....	May to September	August 1 to 5.....
Indian Grass.....	Andropogon nutans.....	July to October...	August 20 to 25....

SPECIES NOT STUDIED—Agrostis olba, Andropogon argyraeus, Eleusine, Astrallensia, Eleusine indica, Eragrostis conferta, Eragrostis geyeri, Eragrostis tenius, Calamovilfa longifolia, Festuca elatoir pratensis, Koeleria cristata, Spartina cynosuroides.

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INDEX.

A.

PAGE.

Admission to College 4
Agriculture, course in 5
Agricultural department 11-13
Agricultural & Mechanical College 3-6
Aid in farmers' institutes by station 8
Alfalfa, as hog pasture 19, 54
compared with blue-stem pasture 83
effect on the soil 69-70
for feeding 18, 53-55
time of sowing 12, 54
varieties 12
yields of hay 54
Analyses of waters 70-71
Announcement of Experiment Station 7-8
Apricots, varieties grown 60
Apple scab, prevention 80
Apples, varieties grown 58-59
Appropriation for buildings 3
Arapahoe, average rainfall 45
Ash, white for shade trees 78

B.

Bacteriology 5
Best yielding varieties of wheat 34
Biology, course in 5
Birch, black 78
Black grapes 61-62
Blue-stem pasture compared with alfalfa 83
Board of Regents 2
Bordeaux mixture 80
Borers in trees 80
Botany 5
Botany, department of 14
Book-keeping, instruction in 5

Digitized by Google

PAGE.

Books, cost of 6
Building a creamery 84
Buildings 3
Bulletins, how to obtain 8
issued since establishment of station 85-86
issued in 1898-1899 10
Bur oak, seedlings surviving winter 80
and red oak, seedings surviving winter 80
Butter making on the farm 82

C.

Calendar, 1899-1900 6
Care of milk on the farm 82
Castor beans 52-53
effect on the soil 69
experiments with 12
value of pods as fertilizer 69
Catalogue of College 6
Catalpas, hardiness 78
Cerebro-spinal meningitis 40
Change in organization 15
Chemistry building, elevation of 76
Course in 5
Department of 14-15
Cherries, varieties grown 61
Cherry, black, for shade 78
Chinch bug infection 14
Civil Engineering 5
Clifton, average rainfall 45
Climatic conditions of Oklahoma 41
Collection of native plants 14
Communications, to college 6
to station 8
Commercial studies 5
Comparisons of corn and Kafir 29
Corn, compared with Kafir corn 20-24
cultivation 50
drilling or listing 49
effect on the soil 67
experiments with ..... 12, 49-50.
feeding value 18
or Kafir, which 51
preparation of soil 49
thickness of planting 50
time of planting 49-50
variety tests 49

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PAGE.

Cornucopia, yield of 49
Cost of attending college 6
Cost of starting a creamery 84
Cotton, effect on the soil 67-69
experiments with 12, 51-52
seed feeding 26
undesirability of extended culture 52
Courses of study 5
Cow peas, effect on the soil 69-70
experiments with 12, 55-56
for swine and cattle 56
Cultivation and soil moisture 62-63
of shade trees 79

D.

Dairying 81
Dehorning, effect of 26
Delay in printing bulletins 10
Digestibility of Kafir corn 73
Digestion trials, with sheep 14
with steers 73
Director's report 9-17
Disease among horses 30

E.

Effect of castor beans on the soil 69
feed on quality of milk 82-83
Electrical Engineering 5
Elm, white, for shade trees 78
Entomology, department of 14
Equipment, value of 4
Expenses attending college 6
Experiments with crops 11-13

F.

Facilities for instruction 4
Facts about milk 82
Faculty of college 4
Farmers' institutes, aid in 8
Farm teams; food, work and cost 31
Feeding experiments, 1896-1899 18-32
in progress 13
alfalfa hay 55
corn and Kafir 71-73
wheat 48-49

Digitized by Google

PAGE.
Financial statement 16-17
Fodder analyses 15
Food of horned toad 14, 38
Forage crops for pigs 30
Fort Sill, average rainfall 44
Fort Supply, average rainfall 44
Fowls as insect destroyers 37
Fruit on the station farm 58-62

G.

Gain of pigs following cattle 29
of steers on full feed 21
partial feed 21
pasture 20, 26-27
General science and literature course 5
German, instruction in 5
Grapes, varieties grown 61 62
Grasses, experiments with 12
native found near Stillwater 87

H.

Harvesting cowpeas 55-56
Hatch fund, statement of 16
Horned toad, food of 14, 38
Horticultural department 13
Horticulture, experiments in 13

I.

Ill formed steer 23
Inoculation experiments for prevention of Texas fever 74
Insects, destruction of 37-38
in stored grain 81

J.

Jefferson, average rainfall 45
June bug 37

K.

Kafir corn, compared with corn 20-24
effect on the soil 67
field experiments 12
feeding value 18
or corn on upland 51

Digitized by Google

PAGE.

Kafir stover 18
Keeping up fertility 64-70

L.

Law governing work of station 7
Library, value of 4
Listing corn, compared with drilling 49
Literature, course in 5
Locust, black, for shade 78

M.

Machine designing 5
Mangum, average rainfall 45
Manure, effect of on moisture 62-63
on wheat 35
Maples, varieties of for shade trees 78
Mechanic arts, course in 5
Medical treatment for Texas fever 75
Mineral matter in waters 70
Morrill fund 3

N.

Native grass pastures 19
grasses found near Stillwater 87
Nomenclature of the Kafir crop 72
Nut bearing trees 61

O.

Oats, effect on the soil 66-67
experiments with 12
yield of varieties 53
Oklahoma City, mean temperature 43
rainfall 44
Organic matter in waters 70-71
in the soil 36-66
Organization, 1898-1899 ..... 2, 9

P.

Pasture for pigs 27-28
Peaches, varieties that set fruit 61
Pears, varieties grown 59-60

Digitized by Google

PAGE.

Pecans, seedlings surviving winter 80
Pie-melons, feeding value 57
Pigs, gains following cattle 29
on pasture—gains 27 28
weight and gain 28-29
Plants, elements in 65
Plums, varieties grown 60
Poisonous properties of castor beans 53
Praying mantis 38
Preparatory department 4
Prevention of Texas fever 74-75

Q.

Quality of milk—effect of feed on 82-83
Quantity of seed wheat 48

R.

Rainfall, average at different places 42, 44-45
for 1899 11
Red grapes 62
Report of Director 9-17
Rocks and minerals 14
Rolling, effect on moisture 63
Rose chafer 37
Rotation of crops, plan 12-13

S.

Scientific German 5
Selection of castor bean seed 53
Shade trees 78-80
Sheep 19, 32
Shelter for animals 19
Silver maple, hardiness of 78
Smut on grasses 15, 30
Soft maple, hardiness of 78
Soil analysis, value of 65-66
Soils, experiments with 11
Sorghum, experiments with 12
Soy beans, experiments with 12
Specialized courses 5
Spring wheat, trials of 49
Station sale fund 17
Station staff 2

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PAGE.

Steer feeding, 1898-9 20-24
1897-8 24-25
1896-7 25-26
Stenography 5
Stillwater, mean temperature 43
rainfall 45
Stock melons, feeding value 57
Subsoiling, effect on moisture 62
Sugar beets, for feeding 57
for sugar making 57

T.

Temperature during year 11, 42-43
Texas fever 74-75
Thickness of planting castor beans 53
Kafir corn 51
Ticks transmitting Texas fever 75
Time of planting castor beans 53
corn 49-50
Kafir corn 50-51
sowing wheat 34, 48
Tulsa, annual rainfall 44
Typewriting 5

V.

Value of apparatus 4
Variation in gain by steers 27
Varieties of corn 49
Kafir corn 50
wheat 33-34
Visiting the college and station 8

W.

Walnut, black, seedlings surviving winter 80
Water analyses 70-71
Water drunk by farm team 31
Waters for irrigation 71
Wayside weeds 77
Weight at birth of lambs 32
of pigs 28-29
Well formed steer 22
Weeds, means of eradication 77-78

Digitized by Google

PAGE.

White grapes 62
Wind, direction and velocity 43
Winnview, average rainfall 45
Work of farm teams 31
the year 11
Wheat, average yield 37, 47
Culture experiments, 1898-9 33-37
effect of manuring 55
effect on the soil 66
experiments with 12
feeding value 48-49
method of sowing 34
preparation of soil 47-48
quantity of seed 48
spring 49
time of plowing 35
time of sowing 34, 48
yield of varieties 33-34, 46, 47

Y.

Yields of varieties of wheat 33-34
Young pigs, rate of gain 28-29

Z.

Zoology 5

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03
4

OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE

STILLWATER, OKLAHOMA

AGRICULTURAL EXPERIMENT STATION .. REPORT, 1899-1900

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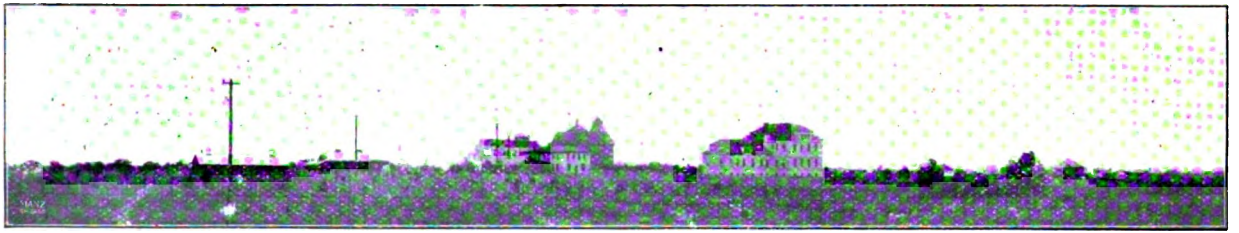

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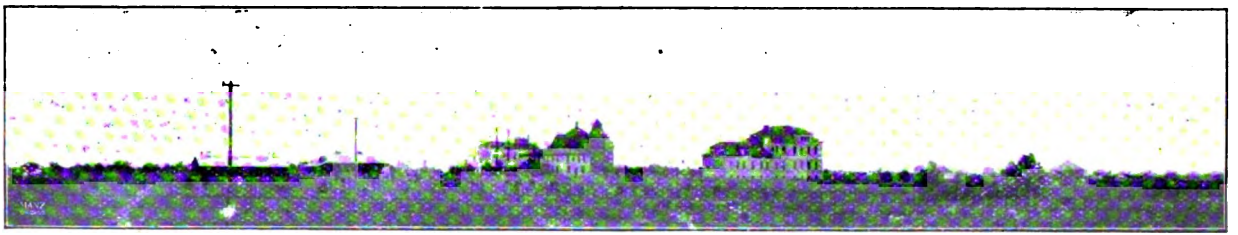

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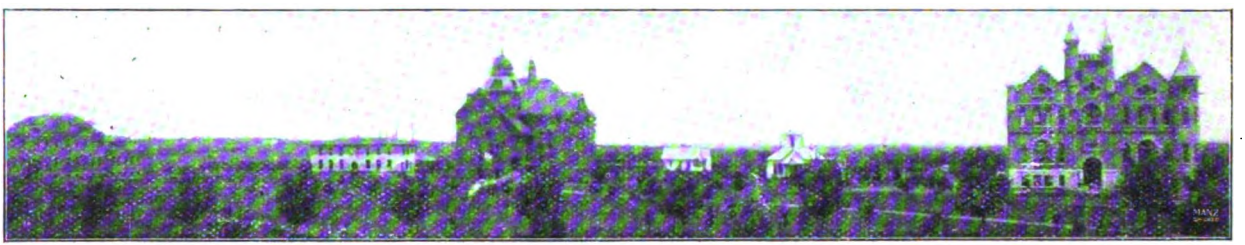

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MISS G. M. HOLT	Stenographer

The publications of the station are sent free to residents of the territory on request. All communications should be addressed, not to individuals or departments, but to the

EXPERIMENT STATION,
Stillwater, Oklahoma.

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EXCH.
IOWA STATE COLLEGE
DEC 10 '36

OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE.

PROGRESS.

Since the last annual report was issued, the college has been strengthened in many directions. Two new buildings, the chemistry building and the library building, have been erected, the faculty has been increased to twenty members, the roll of students has grown to 366 names, the courses of study have been further enlarged, a department of domestic economy has been created, an electrical department has been installed and a foundry equipped, and, generally speaking, the equipment for instruction in all the departments has been greatly increased, its value being now $60,362.69, as against $32,817.68 as shown by the last report.

RESOURCES.

The Oklahoma Agricultural and Mechanical College receives from the government every year the sum of $22,500. This is known as the "Morrill Fund," and is to be expended for instruction and appliances only, the Territory of Oklahoma providing buildings, repairs, etc.

The Agricultural Experiment Station, which is a department of the college, receives from the United States government, an annual appropriation of $15,000, to be used solely for experimentation and the publication of results. This is known as the "Hatch Fund."

The last legislature provided for the annual levy of one tenth of a mill on the taxable property of the territory for the benefit of the college. This, on present valuations, reaches about $4,500. The legislature also set apart one-fifth of the income derived from the rental of the lands granted to the territory for the benefit of the institutions of higher learning. This amounts to about $4,800 per year.

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There are other slight sources of income, not necessary to detail here, which raise the total annual income of the college and station to about $50,000.

EQUIPMENT.—GROUNDS AND BUILDINGS.

The college campus and experiment station grounds occupy 200 acres of land. Four buildings are now occupied for the purposes of instruction and experimentation: The Assembly building (containing the auditorium and lecture rooms;) the Library building (containing the library, lecture rooms, laboratories and museums of the department of biology;) the Chemistry building (containing lecture rooms and laboratories of the department of chemistry, and also the offices and the chemical laboratories of the experiment station;) and the Mechanical building (containing lecture room and shops of the mechanical department, and the printing office.)

LIBRARY.

The college now has a well selected library of 6,000 volumes. As this publication goes to press, the library is about to be moved into the new building, where it will be reinforced by new books now ordered, which will bring the total number of volumes to over 10,000. The best reference books and the leading periodical publications are at the disposal of students.

MECHANICAL DEPARTMENT.

The equipment of this department now includes a machine shop, a carpenter and pattern-making shop, a blacksmith shop, a foundry, and a drawing room, besides the electrical engineering laboratory, all of which are fully provided with the latest and best machinery, instruments, tools, and appliances.

DEPARTMENT OF CHEMISTRY.

This department is now located in the new chemistry building, occupying the basement, a lecture room and office on the first floor, the entire second floor, and the attic—the remainder of the building being occupied by the experiment station. The qualitative, quantitative, and private laboratories are fitted for the best possible service, and the department is equipped with the best modern apparatus, glassware, chemicals, analytical and assay balances, etc.

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DEPARTMENT OF BOTANY AND ENTOMOLOGY.

The apparatus in this department is all of recent make and of the best to be found on the market—including 28 simple and compound microscopes, hand lenses, microphotographic apparatus, camera facilities and slide mounts, collections of plants, insects, woods, fibers, seeds, etc.; wall charts, models, green-house, etc.

DEPARTMENT OF ZOOLOGY AND VETERINARY SCIENCE

The new quarters of this department in the library building consist of a laboratory for general biological work, a bacteriological laboratory, a laboratory for special work, and a lecture room. Among the extensive equipment of the department are twenty compound Zeiss and Leitz microscopes, micrometers and cameras, microtomes, dissecting instruments, dissectible models of various types of animals, skeletons, prepared skins of birds and mammals, etc.

DEPARTMENT OF AGRICULTURE.

The equipment of this department has been substantially increased during the past year. The farm of 200 acres, with the experiments of the station continually under way, is its laboratory. Five breeds of cattle are represented, viz: Short-horns, Herefords, Aberdeen-Angus, Red Polls, and Jerseys. The breeds of swine which will be fully represented by the opening of the academic year are Berkshires, Poland Chinas, Duroc-Jerseys, and Chester Whites; of sheep, Shropshires, Southdowns, Merinos, and Cotswolds. A farm dairy will be equipped in time for next year's use.

DEPARTMENT OF HORTICULTURE.

This department is equipped with complete lines of garden seeders, tools for lawn work, spray pumps, garden tools, charts and models, herbarium, microscopes, etc. It has at its command, also, the extensive vineyards and orchards of the experiment station, including fifty thousand trees and vines, and, for instruction in forestry, a plantation of forty thousand forest trees.

OTHER DEPARTMENTS.

The departments of the English language and literature, of foreign languages, and of history and political economy, are properly supplied with facilities for instruction, and are represented

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with special fulness in the library. The department of mathematics has extensive appliances for demonstration, instruction, surveying, and other practical work. The printing office is suitably equipped for instruction, which is its primary purpose. The regular college publication, *The College Paper*, is issued by this department, under student management, and the general job work of the college, including the publication of the annual catalogue, is done by it. The department of stenography and typewriting is equipped with seven typewriters and other necessary appliances.

FACULTY.

The college has a faculty of twenty members, each specially trained in the department under his charge.

COURSES OF STUDY.

From the above statement it will be seen that the present facilities of the college are ample to give a high-grade practical higher education. Six courses are offered, all requiring four years (exclusive of the preparatory department) and all leading to the degree of Bachelor of Science:

I. General Science and Literature course.

II. Agricultural course—including Horticulture and Veterinary Science.

III. Mechanical Engineering course.

IV. Courses in Special Sciences:

1. Chemistry.
2. Biology.
3. Botany.

The branches pursued in the several collegiate courses may be summarized as follows:

LANGUAGE AND LITERATURE.

Rhetoric, Etymology and structure, theme work, English and American Literature, literary interpretation and criticism; German and Latin.

MATHEMATICS.

Algebra, geometry, descriptive geometry, trigonometry, surveying, analytical geometry, calculus.

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MECHANICS.

Electricity, magnetism, mechanical drawing, kinematics, steam boilers and engines, thermodynamics, machine design, etc.

SCIENCE, PURE AND APPLIED.

Agriculture and horticulture, chemistry, physics, botany, entomology, zoology, comparative anatomy, general biology, physiology, geology, assaying, bacteriology, materia medica, normal and pathological histology, embryology, etc.

MISCELLANEOUS.

Elements of law, political and industrial history of the United States, general history, phychology, sociology, civics, economics, etc.

SHORT WINTER COURSES.

During a portion of the winter term, practical instruction is given in matters directly related to farming, stock raising and fruit growing, and the management of steam engines, with special attention to machinery used on farms. Any person over sixteen years of age may take this work, no examination for admission being required. A circular describing the work of these courses in detail will be issued in November. In 1901, they will cover eight weeks, from January 1 to February 23. The following list contains the work which will be given at that time:

Breeds and Breeding of Live Stock—18 lectures.
Diseases of Live Stock—18 lectures.
Stock Feeding—12 lectures.
Farm Dairying—9 lectures.
Crops for Oklahoma—18 lectures.
Farm Machinery and Equipment—18 lectures.
Steam Engines and Boilers—8 lectures.
Maintenance of Soil Fertility—9 lectures.
Orchards and Small Fruits—18 lectures.
Troublesome Insects—9 lectures.
Elementary Botany—9 lectures.
Farm Hygiene; Water supply—10 lectures.
Legislation and Laws Affecting Farmers—12 lectures.
Farm Accounts, Mortgages, etc.—12 lectures.

Work in carpentry, blacksmithing, steam engines and boilers, veterinary practice, and practical horticulture will be given in the afternoon in so far as the facilities of the college will allow.

The lectures will be supplemented by practical work in the dairy, barns, shops, and orchard, designed to fix and illustrate the methods and practices advised. It is practical instruction

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throughout and planned to give the most that is possible in so short a time.

OTHER SPECIAL COURSES.

The college also offers instruction in stenography, typewritting, and printing.

ADMISSION TO THE COLLEGE.

To enter the freshman class the applicant, under the territorial law, must be at least 14 years of age, and must pass a satisfactory examination in the following subjects: Reading, spelling, penmanship, geography, United States History, grammar, and arithmetic. It is urgently recommended, also, that he be well prepared in physical geography, civil government, and the elements of algebra, as these subjects are covered in our preparatory department.

PREPARATORY DEPARTMENT.

In order to meet the wants of those whose school facilities have not been sufficient to prepare them for the collegiate work, a preparatory or sub-collegiate course, extending through two years, has been provided, which gives a thorough and approved training in all the branches above mentioned, and in algebra, civil government, physical geography, and free-hand drawing. The age limitation for entrance to the freshman class (fourteen years) applies also to the applicants to enter the preparatory department.

EXPENSES.

Tuition is free in all the regular courses. An incidental fee of $1.00 per term is charged all students. A small fee is charged for the use of typewriter. Board and room can be had for from $2.50 to $3.00 per week. Students' clubs are in operation in which good board is obtained for $1.75 to $2.00 per week. Books cost from $2.00 to $5.00 per term. Energetic students can in a measure support themselves by doing work about the college and city.

OPENING.

Entrance examinations for the fall term, 1900, occur September 10-11. Fall term begins September 12. For catalogue and full information address

A. C. Scott, President,
Stillwater, Okla.

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REPORT OF DIRECTOR.

The work of the station has continued to be closely confined to the study of questions bearing upon animal husbandry and the production of orchard and small fruits. To those not conversant with the methods and purposes of experiment station work, this may seem a narrow and restricted field. Exactly the opposite is, however, true and the station is prevented, on account of the limited funds at its disposal, from undertaking much pressing work that properly falls within these lines. Much that is done at other stations is as true for Oklahoma as if the work were done here, and the practical results are at the service of every citizen of Oklahoma. If this station were to attempt to investigate the many problems that are urged as being important, its work would be scattered instead of being broadened. It is only by continued concentration of effort along a very few lines that the station will be able to render the service that should be demanded of it.

SUB-STATIONS.

There is a well-defined feeling in some parts of the territory that the results of experiments conducted here are not applicable elsewhere, particularly in western Oklahoma. This is fostered by a popular misconception concerning the work of the station—a tendency to regard it merely as a place for field trials in the growing of crops. Crops are grown, it is true, but only incidentally and as a means for the study of some general principle of crop production rather than for the greatest yields. It would be desirable, however, if the station had funds available for investigation of certain problems of interest to stockmen of western Oklahoma which cannot be carried out here. The funds for this purpose must be secured from sources other than those provided by the federal government the Department of Agriculture having ruled as follows:

"EXPENDITURES FOR PERMANENT SUBSTATIONS. *

"This Department holds that the expenditure of funds appropriated in accordance with the provisions of the act of Congress of

*Bulletin 74, Office of Experiment Stations, U. S. Department of Agriculture, pp. 101-102.

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March 2, 1887, for the maintenance of permanent substations is contrary to the spirit and intent of said act. The act provides for an experiment station in each State and Territory, which, except in cases specified in the act, is to be a department of the college established under the act of Congress of July 2, 1862. The objects of the stations, as defined in the first mentioned act, are evidently of such a character as to necessitate the services of scientific and expert workers. Most of the lines of investigation named in the act are general, rather than local, and involve scientific equipment and work. It is obviously the intent that the stations established under this act shall carry on important investigations which shall be of general benefit to the agriculture of the several States and Territories. The sum of $15,000, which is annually appropriated by Congress under this act for each station, is only sufficient to carry out a limited number of investigations of the kinds contemplated by the act.

"As the work of the stations in the different States has developed, it has been found necessary to limit, rather than expand, the lines of work of the individual stations. Thorough work in a few lines has been found more effective and productive of more useful results than small investigations in numerous lines. When we consider the nature of the investigations, the amount of money provided for the work of each station, and the fact that the act expressly provides for only a single station in connection with each college, it becomes very clear that expenditures such as are necessary to effectively maintain permanent substations ought not to be made from the funds granted by Congress to the states and territories for experiment stations. The maintenance of permanent substations as a rule involves the erection of buildings and the making of other permanent improvements. The sums of money which can be expended for permanent improvements under the act of Congress aforesaid are so small that it is clear they were not intended to meet the needs of more than one station in each state and territory.

"When the legislature of a state or territory has given its assent to the provisions of the act of Congress of March 2, 1887, and has designated the institution which shall receive the benefits of said act, it would seem to have exhausted its powers in the matter. The responsibility for the maintenance of an experiment station under said act devolves upon the governing board of the institution thus designated. If the legislature of the State or Territory sees

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fit to provide funds for the equipment and maintenance of other experiment stations and to put them under the control of the same governing board, well and good, but this does not in any way diminish the responsibility of the board to administer the funds granted by Congress in accordance with the provisions of said act.

"The wisdom of Congress in limiting the number of stations to be established in each State and Territory under the aforesaid act has been clearly shown by the experience of the few states and territories which have attempted the maintenance of substations with the funds granted under said act. The expense of maintaining substations has as a rule materially weakened the central station, and the investigations carried on at the substations have been superficial and temporary. It is granted that in many states and territories more than one agricultural experiment station might do useful work, and in some states more than one station has already been successfully maintained; but in all these cases the State has given funds from its own treasury to supplement those given by Congress. It is also granted that experiment stations established under said act of Congress and having no other funds than those provided by that act will often need to carry on investigations in different localities in their respective States and Territories, but it is held that this should be done in such a way as will secure the thorough supervision of such investigations by the expert officers of the station and that arrangements for such experimental inquiries should not be of so permanent a character as to prevent the station from shifting its work from place to place as circumstances may require, nor involve the expenditure of funds in such amounts and in such ways as will weaken the work of the station as a whole.

"As far as practicable, the co-operation of individuals and communities benefited by these special investigations should be sought and if necessary the aid of the states invoked to carry on enterprises too great to be successfully conducted within the limits of the appropriation granted by Congress under the act aforesaid."

In conformity with the spirit of this ruling, the station is now pursuing such investigations in different sections of the territory as may be successfully carried out with the co-operation of farmers and others. Much valuable aid has been given by our correspondents, the results of whose experience are of great assistance. It is not possible, on account of the expense incident to the investigations being carried on at the station, to establish even

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temporary substations. Study of problems as they arise on the farms and in the orchards is more productive of valuable, practical results in certain lines than trials on the grounds of the station and this method is being utilized to a great extent. Plant diseases and insects and diseases of animals can be studied to advantage only when they occur, and a method of treatment successful in one locality is almost certainly so for all. But the real, scientific work of the station can be done only at the station, where the facilities afforded by the laboratories, records, and library are available.

SUBJECTS OF INVESTIGATION.

The experimental work with wheat consists of comparisons of early, medium, and late plowing and seeding, and a further comparison of a small list of varieties. An inquiry is also being made of wheat growers throughout the territory as to the methods pursued and the results secured on a large scale.

Continuous cropping experiments, both with and without manure are being conducted with wheat and Kafir. Two series of rotations, one of corn, oats, and wheat and cowpeas, and another of castor beans, Kafir, cotton, oats, and wheat and soy beans are in progress, duplicate plats being used in each case with and without manure. The production of forage crops is also receiving much attention.

Feeding experiments with steers have consisted of trials using Kafir meal, corn meal, alfalfa hay, and Kafir stover for fattening. A partial summary of one year's trials is published elsewhere in this report, and a duplication of this work has been planned for the coming winter. The cost of wintering yearlings and gains on summer pasture are also being studied.

Pig feeding experiments, using Kafir corn and cowpea hay and similar crops have been begun. Further work is also being done with the feeding of cottonseed and cotton seed meal to hogs.

Arrangements are being made for feeding trials with chickens, particularly with regard to fitting them for market. The details of this important industry here require further investigation and study, particularly with regard to the utilization of the feed stuffs available on the farms. Trials of digestibility of Kafir, corn, and cowpeas have been made and further work is planned along this line.

Studies of the digestibility of forage crops are also being made. It is planned to control feeding experiments in the future by di-

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gestion trials using the rations fed. In this manner it will be possible to study the influence of different feeds and trace the cause of the difference in results.

Closely connected with this work is a study of the prevalence of blackleg among cattle in the territory and of the efficiency of vaccination as a means of prevention. Parasitic diseases and the means used to rid animals of parasites is also receiving attention. The working out of a successful method of inoculation for Texas fever by the Missouri and Texas Stations has added greatly to the possibilities of stockraising in the territory and information concerning it is being furnished to those interested and further tests are being made here.

The study of the flora of the territory is being continued as time will permit. The transmission of the crown knot of the apple by soil infection and a very destructive root rot of apple trees are being investigated with promise of valuable, practical results. The chief work with insects consists in studying those that are destructive to crops and in devising means for their extermination. Work with Italian and Carniolan bees is being carried on with a view of determining, in a measure, the probable prospect of successful bee keeping in Oklahoma.

Variety tests of fruits as mentioned in the last annual report of the station are being continued. These comprise almonds, apples, apricots, blackberries, cherries, currants, dewberries, grapes, peaches, plums, quinces, raspberries, strawberries and pears. In addition, methods of cultivating, pruning, and trellising grapes are being compared. Frequent reports are received from practical fruit growers and the results of their experience compared with those secured at the station.

As a necessary adjunct to fruit growing, much work is being done with spraying, both on the station grounds and in private orchards where opportunity for the study of some specific problem is presented.

The problem of securing material for fence posts and cheap buildings is one that is engaging the attention of many. This consideration alone, to say nothing of the many other features, has led to the establishment of a forestry plantation. Mention of this is made in another place.

The foregoing constitute the chief lines of work now being carried on by the station. There is much miscellaneous work, such as the testing of new and old varieties of grasses and forage plants seeding and improvement of alfalfa fields, identification of plants

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and insects, examination of waters and rocks, advice concerning prevention and treatment of diseases of livestock, planting trees for shade about home grounds, and a host of minor investigations that fit in with the routine work of the station and add to its practical value. The constant effort is, however, to adhere closely to the true purpose of the station and to conduct the work along the lines that have been determined upon, after careful consideration, as being the most important and far-reaching for the agricultural interests of the territory.

BULLETINS ISSUED.

The following bulletins have been issued during the year and are still available to those requesting them.

No. 43, November, 1899.

Fruits for Oklahoma, by O. M. Morris.

Best varieties of apples, pears, peaches, plums, cherries, grapes, blackberries, apricots, currants, and raspberries for Oklahoma are discussed, together with suggestions concerning planting and caring for shade trees.

No. 44, December, 1899.

Field crops, 1899.

This bulletin gives a brief report of experiments with oats, Kafir corn, corn, castor beans, and cotton conducted by the station during the crop season of 1899.

No. 45, March, 1900.

An Annotated Catalogue of the Ferns and Flowering Plants of Oklahoma, by E. E. Bogue.

A complete catalogue of the native plants of the territory is given. Both the scientific and common names are stated and notes as to locality and value. A popular summary of this bulletin was issued entitled, Native Oklahoma Plants.

No. 46, May, 1900.

Digestion Trials, by John Fields and A. G. Ford.

This is a preliminary report of studies of the digestibility of Kafir corn, corn, and cowpeas when fed to chickens and of fodders of Kafir, corn, large and small sorghum, black rice corn and milo maize when fed to sheep.

In addition to these, Press Bulletins No. 50 to 61 have been issued and sent to the newspapers of the territory and to an extensive list published in other states.

To a most unusual extent, the newspapers circulating in the territory have given wide publicity to the work of the station.

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Dailies published in the territory, in Kansas City, and in Wichita have in several cases given space in their columns for a complete reproduction of bulletins of the station. One weekly, published at Guthrie, reprints all of the bulletins, thus giving them a publicity that otherwise could not possibly be secured. The county weeklies also make large use of the press bulletins and appreciation of this is shown in the letters received from farmers commenting upon this practice.

BUILDINGS.

There has been much improvement in the space available for the work of the station. A building for the joint use of the departments of chemistry in the college and station has been completed, the station laboratories and offices occupying about one third of the space and being entirely separate from the rest of the building. The building formerly used as a chemical laboratory is now occupied by the agricultural department. With the completion of the library building, the veterinary department will have a satisfactory station labratory and space will thus be made available for the horticultural department which is now without quarters suited to the work in hand. Sheds and feed yards for use in steer feeding experiments have been constructed and provision has been made for the erection of sheds for the storing of forage and implements. A small piggery is also being built and will furnish much better quarters for experiments in pig feeding.

MAILING LIST.

There has been an increase of more than one thousand names on the mailing list during the past year. The list has been arranged on cards so that it can be readily consulted and revised. The regular edition of bulletins is now 15,000 copies, about 14,000 of which are sent out at once and the remainder reserved to supply requests.

CORRESPONDENCE.

The nature of the correspondence received by the station is changing, due perhaps to a better popular understanding of what are the objects and purposes of the station. Formerly, it consisted largely of requests for seeds and plants, which of course the station was unable to furnish. Now the inquiries are usually for information concerning some question of interest on the farm. These are cheerfully received and answered, since they furnish

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a means for making known the work that is done here and for learning of the difficulties that confront our farmers and stockmen in their work. Frequently, these letters suggest timely topics for press bulletins and subjects for investigation and inquiry by the station.

FARMER'S INSTITUTES.

A persistent effort was made during the year to organize a system of farmers' institutes but resulted in complete failure. But one institute was attended and the attendance at this was very small. In the absence of some definite institute organization, so that meetings may be arranged in a circuit and attended without wasteful loss of time and expense, it appears that the station must seek another way of doing this work. This it is doing to a large extent through correspondence and by attendance at the meetings of the different agricultural and livestock associations which are held in the territory. Three of these associations will hold their next meetings here, all of them beginning on the fourth of December, and continuing for several days. It is hoped that at this time many will avail themselves of the opportunity to visit the station and attend the meetings.

THE STAFF.

The only change in the personnel of the station staff during the year has been the addition of an Assistant in Agriculture necessitated by the extent and character of the work in that department. Mr. J. G. Kerr, a graduate of the Texas Agricultural College, has filled this position acceptably since January. In every particular the officers and employes of the station have labored faithfully and efficiently toward the development of an experiment station in which each of the departments co-ordinates with and assists the others. In this way only, it is believed, can the station be maintained on a satisfactory working basis and be in a position to fully answer a few of the varied questions that are presented to it.

Prof. E. E. Bogue, station botanist and entomologist, has been granted a leave of absence for the purpose of studying certain plant diseases that have been engaging the attention of the station. Dr. E. M. Wilcox will be in charge of these departments during the coming year and work in conjunction with Prof. Bogue in the investigations now being carried on. Aside from this the staff remains unchanged.

June 30, 1900. JOHN FIELDS, Director.

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THE WORK OF THE EXPERIMENT STATION.*

John Fields.

Connected, as is the Oklahoma Experiment Station, with the Agricultural and Mechanical College, its functions are not clearly distinguished from those of the college. Briefly, the work of the station is to discover new truths or new applications of old ones, connected in any way with the great, many-sided industry of farming, and to publish the results which it has secured. The work of the college, on the other hand, is to place systematized knowledge bearing in any way upon agriculture or the mechanic arts, in a shape available for those who wish to acquire it. The whole field of knowledge is open to the college and to those who wish to utilize its advantages. The station has a few specific questions to answer and the answering of them must be done in such a way that there is no uncertainty, no doubt, no revision.

It is now eight years since the establishment of the Oklahoma Experiment Station. The question is many times asked, "What has the station done for the farmers of Oklahoma?" If I felt that an apology for the work of the station were necessary, I might reply that the farmers of Oklahoma have no right to complain as they have never contributed to its support. But I have no apology to make. Acquainted as I am with the work of the stations in the United States and with many of the men who are working in them for the advancement of agriculture, I am not at all ashamed of the work of Oklahoma's station.

Those of you have been through the trying days after the various openings—through the wearisome effort to make something where nothing was—must know that every enterprise had to pass through the same experience. You must know that the establishment of an institution for accurate experiment and research also had its immense amount of work to be done before a showing could be made. Would a meeting and an exhibit of the sort that we have here now have been possible five years ago?

What has the Oklahoma Station done for the farmer? Much. I shall not tire your patience with a recital of what has been done.

*Address before the Oklahoma Agricultural, Horticultural, and Irrigation Association, Oklahoma City, August 19, 1899.

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The published bulletins—42 in number—and the summary of the results now being sent out tell of the results in a plain, practical way. It makes rather dry reading to an admirer of the beautiful in literature but it would be dryer still were I to attempt to talk it to you.

Two points occur to me which will furnish data in answering the question "Has it paid?" In a bulletin issued more than a year ago, it was stated that castor bean pods were worth ten dollars a ton as fertilizer. Castor bean pods had never been studied before and their value was not recognized. Let us imagine that every grower of castor beans made good use of the pods after their value had been made known to him. At ten dollars per ton, 1500 tons would pay for the cost of the station for a year. Are there 1500 tons of castor bean pods wasted every year? Of course there are, many times that many.

The station has done much to help in forming a correct estimate of the value of Kafir corn. It has grown it under varying conditions, fed it in different ways, and published several bulletins about it. One point only—it has shown that 100 pounds of Kafir meal is equal in feeding value to 166 pounds of Kafir corn. Everyone knew that there was a difference but they didn't think that it was half so great as that. Give the station credit with the other half—it has saved 5 cents on every bushel of Kafir corn fed. Are there three hundred thousand bushels of Kafir corn fed each year? At the five cents per bushel which the results of the experiment station have added to its value, the $15,000 which the Station costs, not the Territory but the government of the United States, has been saved. These are but two examples—I might enumerate a hundred.

Let me cite just one more illustration. Last summer, about this time or a little later, a complaint reached us from Garfield county that the farmers' horses were dying. Our veterinarian started over, drove all of two days and nights visiting different places where the disease appeared, and got back looking much the worse for wear. He found that a smut growing on a certain variety of grass was the cause—a bulletin was sent to the newspapers and to the farmers in the locality where the disease was prevalent. In this way and by correspondence, the farmers were told the cause and the easy way of avoiding the trouble—simply by keeping their horses out of pastures in which the smut was present. In reporting the cause of the trouble, we called it "smut on grama grass"—we might have said that it was "Ustilago bouteloua growing on Bouteloua oligostachya" which is the Latin of it. But we didn't do

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it. The loss of 300 horses at $50 apiece means the loss of $15,000. By pointing out the way of preventing this loss, the station has again paid for what it costs.

In each of the cases cited, there was a possibility of doing something for a large number. If only a few horses had been sick or a few cattle were dying, it would have been none of our business. The station does not maintain free veterinary service or free service of any other sort for individuals. But when an opportunity arises for us to do work which is of service to many, not only at the immediate time, but for the indefinite future, all of the facilities of the station are turned loose on it and we do the best we can.

I do not mean to say that the results of the Station's work are made use of as I have indicated. But there are the results—the station has done its work. It is up to the farmer and the question is "What is the farmer doing for the farmer?" He too is doing much. Oklahoma has progressed in such a remarkable manner and has acquired such a world-wide reputation as a farming locality that we, appreciative as we are, do not fully realize its capabilities. When two years ago on the experiment station farm, which has been reviled as the poorest of the poor, sixty-five different varieties of wheat averaged a yield of 39.6 bushels per acre with 19.6 as the lowest and 57 as the highest, I looked up the results of similar experiments in other states and found none equalling it. It was a record breaker and the record still stands.

As to the future of the station, to be of greatest use, its work must be mainly along the lines which are and must be the great industries of Oklahoma. As I see them, they are summed up in what is termed "diversified farming." I hope to see the day when every farm in Oklahoma will have its little herd of pure-bred beef cattle, its bunch of hogs and its flock of sheep; when every farmer will raise, feed, and fatten his bunch of steers and realize the top of the market because they were bred in new Oklahoma and are of the best; when every farm is made to grow a small acreage of each of the many crops that may be grown and is self-supporting. The tendency to exclusive farming in some localities is not a hopeful sign. While at present remunerative, experience teaches that it will not continue to be so.

This society does well to combine all the varied interests into one compact association where they belong. The orchard and garden has its place on every farm and so has the cow, the hog, the sheep, and the clucking hen, each of them contributing its share

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to the comfort and support of the farmer's family. In February last, at Vicksburg, Miss., a convention of southern farmers was held for the purpose of discussing the agricultural problems of the south. Prominent agriculturists from all over the country were present and addressed the convention. These addresses have been summarized and published in a farmers' bulletin of the department of agriculture. The keynote of all of these addresses was "Grow many crops, do not depend upon one crop, but utilize stock to the greatest extent and thus secure greater returns and at the same time, keep up the fertility of the soil."

These meetings do much in the way of setting people to thinking Farmers' institutes are of great value. And while on the subject of farmers' institutes, let me indicate the manner in which the Agricultural College aids in this important work. We wish if possible to send out some one to assist in each institute which is held in the territory. The funds at our disposal for this purpose are limited and we must always arrange that the man we send out will be able to attend at least two meetings while on one trip. The list of meetings is now being made up for December, January and February next and those wishing help in their institutes should arrange at once for aid from the station.

The work of the station has always been conducted with a view to securing practical results. When a new line of inquiry or experiment is suggested, our first question is "of what immediate, practical value will the results be?" "In what way will it help our farmers make more money or keep from spending what they have made?" The plan that stands the tests of these and other similar questions is adopted and followed out.

On the farm at the present time, field experiments with everyone of our numerous crops are in progress. Chief among these are cultivation experiments including preparation of the soil and various methods of cultivating the crop. Along this line, that of the true method of handling the soil so as to save all of the moisture for the crop, we *know* but little—many people *think* they know it all. The glowing newspaper accounts of somebody's great discovery for growing crops without water, and someone else's plan of salvation for a sunburnt crop make entertaining reading when contrasted with an experiment station bulletin in which the author is careful to state only what really did happen, not what he wanted or expected to happen.

Some striking results are shown in the little exhibit which we have brought down from the station. Perhaps the most noticeable

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one is the great difference in the yield and quality of wheat from sowing at different dates. I might say that the only time to sow wheat is in September—do not these results prove it beyond the shadow of a doubt? No, they do not. They show that it paid to sow early last season. Results in other years have been similar but it is not certain that it will always be best to sow in September. Rainfall, temperature, and other conditions may make October sown wheat better next time. All that we can say is that the average up to this time is in favor of early sowing and that it is probable that early sown wheat will give the highest yields.

With fruits the general principle is the same with the exception that a greater length of time is required to obtain any results at all. The greatest number of questions is about varieties. It takes us as long to find out about this as it does anyone else—and when we have obtained some results, we can't always give them the broad, general application that is demanded.

The departments of Botany, Entomology, and Veterinary Science must work even longer for results that tell and are of service. It is true that we send out chinch bug infection to those who apply for it, but we do not regard that as of much importance since the manner of growing the fungus and spreading it has been explained in our publication so that the enterprising and studious farmer may make it for himself and have it at hand when he needs it. Just now, the entomologist is tackling a bigger job. He hopes in a year or two, perhaps three, to find some parasite or disease that will kill the pesky little horn flies that are worrying the cattle almost to death. He may succeed; he probably will not. Yet the cattle interests of the territory are of such importance that a few years of hard, earnest work with a faint promise of success may well be spent in this direction.

Our veterinarian is continuing to give his attention to the study of Texas fever and hog cholera. He has spent the last month in the Bureau of Animal Industry at Washington studying the new serum treatment for the latter which has been worked out there.

Our Horticulturists are working on a matter of vital importance. Apple trees eight to nine years old have been dying in some localities—the roots rot off and the tree dies at the surface of the ground. The problem is an exceedingly difficult and important one and we would be glad to have reports of this trouble wherever it occurs. We do not know what it is. I have been told by men who were certain that they knew that it was several different things, depending on the man who told me. It cannot be all of

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these things, it may be none, yet we need and want your help in finding out about it.

And now I wish to speak a word in behalf of the boys and girls growing up on the farm. They do not always have a good time but they have natural opportunities far superior to those of anyone else's children. And here in common with others in this great territory, they have an opportunity to acquire an education of a practical sort at very small expense. "What," you say, "go to college to learn farming?" No. Widen the range of your vision. Agriculture in its modern sense is a profession requiring for its best and most successful pursuit a training more thorough, broader, and more exact than that of a doctor, a lawyer, or a preacher. On the basis of the agricultural interests of the territory rests all else. Why, then, should not agriculture receive a great share of attention in our educational system? We are not ashamed of our course in agriculture. We are proud of it—proud to say to the farmers' boys "Come where you can get a training that will make you a leader in that agricultural advancement that is sure to come with the new century." With a farm of 200 acres devoted to experimental work in agriculture, horticulture, and allied subjects, with the beginnings of a herd representing the different types of beef cattle, with hogs and sheep and poultry for experiment, study, and observation, with all of these and only well-begun, why should I not say "Come?"

And in the same way along horticultural lines, our orchards and vineyards contain hundreds of different varieties available for the instruction of those whose tendencies lie in that direction. In chemistry, botany, zoology, entomology, and veterinary science, subjects on which the very foundation of agriculture rests, we have a complete equipment of apparatus and experienced instructors. The student of agriculture learns in the shops how to handle tools, working in both wood and iron, gets acquainted with machinery of all sorts, and goes out from the institution thoroughly equipped for the work which is before him.

He may have known how to plow before he went to college—when he leaves it he knows when and why. He may have known enough to keep the weeds out of the corn—when he leaves, he knows that it frequently pays to plow corn when there are no weeds to be killed. But it isn't so much what he knows as it is the ability to find out things which his college training has developed—ability to grasp a new condition of affairs and adapt himself to it.

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And while I am speaking of the College, it is not unbecoming, I trust, for me to tell something of its work along lines other than agriculture. Twenty-four young men and women have graduated from the institution in the last four years. Some of them are farming, some have gone to institutions in the east, one to Cornell and two to the Pennsylvania State College, and continued their studies. We are better fitted than ever with the two new buildings which are being erected.

A course in general science and literature, in agriculture and horticulture, in mechanical engineering, in chemistry, in botany and in biology certainly affords a sufficient range for choice to any boy or girl that wants to work. Many boys and girls are sent to far less efficient institutions each year because their parents do not fully appreciate what they have at home. The best has been gathered from all over this broad land and placed at your disposal for the education of your children. It does not pay to send them off to some weak little institution in Kansas, Texas, or Missouri "back where you came from" when right here is something better if you will realize it and come to your own.

I have been frank with you—all of us are working toward the same end—each of us is taking a slightly different route. You in your work are free to choose your path—ours is mapped out for us in the law establishing the College and Station. We are honestly trying to help you in your work—we need your help in ours. The greatest help which you can give the farmers of Oklahoma is by encouraging them to study and find out what is already known thus leaving the station time and opportunity to find out what is not known.

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MEANS OF PREVENTING TEXAS FEVER.*

L. L. Lewis.

The subject assigned has a double interest to stockmen in Oklahoma because we are situated on the dividing line between the infected and non-infected territory. Large areas of the territory that are below the quarantine line are free from infection and cattle raised on such pastures are susceptible to Texas fever, and so in moving our native cattle from one locality to another a certain per cent. becomes infected and may die from this cause.

To first consider the importance of preventing fever among our native cattle, it is of primary importance to recognize the cause of the disease. It is not my purpose to discuss this side of the question but in connection with my subject I will state that so far as any experimental evidence is concerned, the tick is the only means in nature of conveying the disease from one animal to another, and in the absence of the tick there is no Texas fever. By pasturing on ground that is free from infection there is no danger of cattle dying from Texas fever. This means is not always possible in infected territory and requires more care and attention than most men will give it in order to make it successful, but if this method is carefully followed out there can be no danger of loss, but the slightest negligence in the way of introducing an infected animal into such a pasture would soon infect the pasture and probably most of the cattle in the pasture. This method of placing cattle (susceptible animals) on pastures free from infection and keeping the animals from coming in contact with infection is the only means of absolutely preventing Texas fever. Such a method of handling cattle will not produce immunity and is of little value so far as the general distribution of cattle among stockmen is concerned.

The Missouri Experiment Station conducted some experiments to determine the protective value of blood serum from southern cattle when inoculated into susceptible cattle, but so far as practical results are concerned in giving protection to susceptible cattle, the results were negative.

*Address at meeting of Oklahoma Live Stock Association, El Reno, February 15, 1900.

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It appears that experimentally the only way to produce immunity is to produce a mild form of the disease either by infesting the animal with ticks or by inoculation with a small quantity of the blood from an immune animal which will contain the micro-parasite causing the disease. The method of producing immunity by tick infestion is not as reliable in its general results as could be desired and will hardly be practiced to any extent as more accurate and trustworthy results can be obtained by using the blood from a southern animal.

If tick infection is used at all it should be practiced in the late fall as the disease will assume a much milder form at this season than at any other time of the year, and if the infection is mild the disease may be controlled to a certain limit.

The recent publication of a bulletin from the Texas and Missouri Experiment Stations has added new interest to the method of producing immunity by blood inoculation as the record of a number of tests made in a commercial way is given. The fact that the inoculation of immune blood into susceptible animals promises to be a valuable remedy to prevent a fatal form of Texas fever in animals shipped south should not cause anyone to regard the method as being safe under all conditions or one that can be successfully carried out by every one who undertakes the work. There are certain essential things to observe in connection with blood inoculation and to neglect any of them is to cause a possible failure in the entire work. From work already reported it is certain that cattle from seven to twelve months old are to be preferred. This age or even as young as six months is preferable to bring south regardless of the method to be used in rendering them immune. Whether they are to be turned on infected pastures late in the season and receive no further attention or if they are to be infected artifically with ticks or to be inoculated with blood the young cattle are to be preferred to mature stock.

The method of securing the blood and injecting it into the cattle are details easily understood by those familiar with similar work. The effect of the inoculation in a majority of cases is to cause a mild form of the fever but in some the fever may prove fatal. The effect of the inoculation to render the animal immune to fever cannot be compared to the effect of vaccinating to prevent black-leg in cattle.

In the latter case no noticeable symptoms follow the operation while in the former every symptom of the fever is seen and the

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calves will often require every attention and frequently medical treatment in order to resist the disease. After the cattle are inoculated with blood they should be well cared for for a year and if possible exposed to a light tick infestion the first summer.

Inoculation may be performed at any time of the year but in our climate the best results will probably be obtained by inoculating during the winter or spring and giving the cattle some extra attention the first summer. They may be inoculated either before or after being shipped south but the latter method I think will be preferable, allowing the calves to become accustomed to their feed and surroundings before they are inoculated.

Further work along this line will probably change to some extent the details of the work but the method in the present stage offers every inducement to the southern breeder to ship to the southern stock farm and ranch the best breeds of cattle found in the north.

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HOG CHOLERA.

L. L. Lewis.

Swine diseases do not assume the same importance in Oklahoma as they do in some of the northern and central states where hog raising is developed to a much greater extent but these diseases are of as great importance to the individual stock raiser in Oklahoma as in any other locality. As Oklahoma develops in agricultural resources it is probable that hog raising will be one of the best developed industries with the general farmer.

It is not the intention of this article to discuss at length any of the new remedies or cures for hog cholera but to describe briefly the cause and nature of the disease, how to recognize it and how to use such means of prevention as are in the reach of every farmer.

Whenever a fatal outbreak of disease occurs among swine it is reasonably safe to assume that it is either hog cholera or swine plague, or both, as the two diseases are frequently found to exist in the same animal, and so far as any ordinary means of controlling the disease is concerned any method suitable for controlling hog cholera will answer equally well for swine plague. The diseases not only resemble each other in symptoms during the early stages but they are both caused by bacteria and the disease can only be checked by such means as will prevent exposure to the germs causing the disease, or that will destroy the bacteria after the hogs are infected. Hog cholera is generally more prevalent than swine plague and in mixed infections the symptoms of hog cholera are more pronounced than those of swine plague.

The first symptoms of the disease are generally not sufficiently pronounced to enable any one to say whether the disease is cholera or not and in the first appearance of the disease in a herd it frequently assumes an acute form, the animal living from a few hours to one or two days. In such cases a post mortem examination may not enable any one to make a correct diagnosis. In most cases the disease is slower and the symptoms become well marked. The most noticable symptoms are loss of appetite, a feverish condition accompanied by fits of shivering and an unwillingness to move.The bowels

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may be normal at first but after one or two days there is a persistent diarrhoea which generally continues throughout the course of the disease. The eyes soon become weak, congested and watery, and later the lids are partly gummed together with a thick yellowish exudate. Coughing is frequently noticed and may become very severe. Almost a constant symptom where the disease continues for several days is the reddening of the skin in spots on the lower portion of the body, inside of the thighs and under the neck. If the disease is swine plague instead of hog cholera the symptoms of lung disease will be more marked, as difficult breathing and a severe cough.

The duration of the disease may be from a few hours to two or even three weeks. Cholera is very fatal to young pigs and will often attack them when older hogs escape.

The principal organs to be examined in making post mortem examinations are the intestines and the lungs. If the animal has been sick one or two weeks the lesions are apt to be well marked. The intestinal ulcers of hog cholera will be seen in most chronic cases by carefully opening the small intestine where it joins the large intestine. The ulcers are located around the valve between the large and small intestine. These ulcers vary in size, are circular in shape and vary in color from a deep yellow to brown or black. They can be felt on the outside of the intestine as hard solid growths in the intestinal wall. The lymphatic glands in the region of the ulcers are frequently enlarged and firm. In the acute form of hog cholera the membrane lining the intestine is congested and this is frequently all that can be seen on post mortem.

If the disease is swine plague the principal lesions will be found in the lungs. By cutting into the lungs they will be found to contain a large number of small yellow masses which is dead tissue. Sometimes large masses of yellowish cheesy material will be found. In some place the lungs will be found collapsed with general congestion of the lung tissue.

The bacteria which cause hog cholera grow in the blood vessels and collect in small clumps in the capillaries, plugging them causing the blood to escape into the surrounding tissue. This is the cause of the red condition of the skin and the congestion of the intestines. Small red spots are often seen in the heart muscle, pleura and pericardium from the same cause.

The cause of the disease is a germ or bacteria, the bacillus of hog cholera which causes hog cholera and the bacillus of swine

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plague which causes swine plague. These diseases do not occur without the presence of these germs and any neglect or bad care the animals may receive does not cause the disease but only lessens the vitality of the animal so they are more susceptible to the disease.

The germ may enter the body by the lungs or by the alimentary canal. The germ of hog cholera most frequently enters the alimentary canal with the water and food while the germ of swine plague causes disease by entering the body through the lungs.

The germs of both diseases can be cultivated in the laboratory and the disease produced in hogs (1) by feeding them the germs (2) by causing them to inhale the germ, or (3) by injecting the germ into the circulation. Animals in infected pens contract the disease by inhaling or eating the germs.

The swine plague germ is easily killed, its vitality lasting under ordinary conditions from one to three months but they may under very favorable conditions remain virulent for a greater length of time. The hog cholera germs are very resistant to destructive agents and retain their vitality for several months unless killed by extreme cold weather. Infected pens should not be used for hogs for a year unless they have been very thoroughly cleaned and disinfected and this is something very difficult to do and practically is never done.

The fact that the cause of the disease is a germ which will live for a considerable length of time makes it possible for the infection to be carried from one farm to another by any animal going from infected pens to healthy pens, by birds, by water running through several farms on some of which the disease exists, or by people passing from one pen to another.

As a means of prevention, hogs purchased from unknown parties or even from adjoining farms should not be placed in the lots with hogs belonging to the farm until they have been kept in separate pens for three or four weeks. Carelessness in this matter is frequently the cause of the loss of almost the entire herd from cholera. Too much care cannot be used in allowing new purchases or hogs from adjoining farms to run in the pens of what are known to be healthy hogs. If a stream runs through the hog lots and cholera appears on farms above, the hogs should not be allowed to drink the water, but fenced away from it and supplied from a well. By exercising such care a considerable loss may be prevented.

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Very little can be said in regard to the matter of treatment of sick animals. No treatment has been found that is considered a cure and almost every remedy that has been offered has been tried by hog raisers.

In some outbreaks of cholera the disease is in a mild form and most of the sick animals recover. If in such a case some remedy has been used it is advertised as a cure while the next outbreak may be a fatal form of the disease and the remedy is found useless.

Hogs should be allowed an abundance of green feed during the summer season. This can be secured by growing sorghum or by sowing wheat or other grains for grazing purposes.

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DIVERSIFIED FARMING IN OKLAHOMA.

John Fields.

INTRODUCTION.

Ten years of experience in a new and untried section of country, such as was Oklahoma so short a time ago, has developed and indicated to a great extent its possibilities. The peculiarities of soil and climate are, in a measure, known and understood by those who till the soil, sow the seed, and reap the harvest.

Perhaps the greatest single feature that is most fully recognized is the unusual number and variety of products that may be grown and matured. The farmers who came to the new country were from every state in the union and brought with them knowledge of the crops and methods to which they were accustomed. Farmers from the states north, south and east settled in the same township and the result has been a system of agriculture which is unique in many ways. The nature of the population has been such as to preclude the hazardous system of growing only one or two crops. Exactly the opposite, a wide diversification, has contributed largely to the prosperity enjoyed during the past decade by the farmers of the territory.

In the following pages, the chief features of the present system are recorded and further possibilities are indicated. Certain lines of agricultural industry may be handled best by specialists but for the greatest number, a judicious diversification is desirable.

CLIMATE.

The climate of Oklahoma is an approximate mean between that of Kansas on the north and northern Texas on the south. In winter, the temperature seldom reaches zero, and in summer, a maximum of 105 is not unusual. The continuous breeze in summer renders the heat less oppressive than in states north and east. Violent storms are no more frequent than in other sections of the country. The number of cloudy days is small, the records showing nearly 75 per cent. of the total possible amount of sunshine during the year.

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The rainfall decreases gradually from east to west, but is sufficient in amount for the maturing of crops, varying with the nature of the soil and location. Much of the high land is used to best advantage when the native grasses are pastured or cut for hay. This is true of all parts of the territory. It is equally true that almost any crop may be grown on bottom land in even the dryest sections. And between the moist bottoms and the dry uplands are large areas which yield profitable returns to the farmer when intelligently handled.

CROPS.

The location and character of the soil should be carefully considered when planning for the crops to be grown. There is probably no single farm in Oklahoma on which all of the crops mentioned in what follows can be grown with profit, yet on every farm, many of them will give profitable yields. Experience and judgment after trials on a small scale must determine what shall be grown. Constant changing and shifting is worse, if anything is worse, than growing but a single crop. Seeking after novelties and marvelous things usually results in loss. A series of crops that keeps the farm force at work during the whole of the year is good business and it pays. When this condition is reached and each crop yields a profit, the ideal possibility of farming in Oklahoma has been attained. Farming then is not a combination of spurting and loafing, but is a steady business.

WHEAT.

History is repeating itself in Oklahoma. Too many farmers are growing nothing but wheat. They did the same thing elsewhere and left when the soil ceased to produce wheat. There is no magic here which will make the result different from what it was there. Continuous wheat growing may not exhaust the fertility of the soils, but it will make them cold and clammy and hard and useless.

There are, however, many mitigating circumstances and Oklahoma wheat growers have had excellent reasons for growing nothing but wheat up to the present time. Money was needed and wheat growing has brought the money. The change from the sod house to the comfortable dwelling has been rapid and tends to inspire increased confidence in the crop that has brought it about. There is perhaps nothing else that would have done it so quickly.

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The trying period is now happily past—wheat growers have plunged and won. It is now time that they should make their winnings secure.

To do this, they need not abandon wheat entirely nor suddenly. A gradual change to a more diversified system should be brought about. In part, this is already being accomplished by the wheat itself. The excellent winter pasture which wheat affords is being partially utilized and the number of cattle is increasing. With these cattle must come other crops for their support and fattening.

Little need be said of methods. Early plowing and early seeding are advised by nearly all and practiced by those who can. The one great mistake that is nearly always made is the waste of manure and straw which so greatly increases the yields when worked into the soil. The city manure pile on the outskirts of one of the principal cities in one of our great wheat counties is a smouldering and, in some respects an impressive pile typical of improvidence and waste.

Many farmers could grow more wheat to advantage and many could grow less. A decrease in the total acreage need not result in a decrease in the total crop and ultimately, will prove of lasting benefit and advantage. It cannot be too strongly urged that straw-burning should cease and that the straw and manure should be returned to the land. If this is done, the period of continuous, profitable wheat culture may be greatly extended. If it is not done, experience the world over teaches that the end will soon be reached, no matter what the original fertility of the soil may be. (See Summary of Press Bulletins, page 62.)

CORN.

This great crop is next in importance, perhaps, to wheat. In common with wheat, it is a staple crop for which there is always a market at some price. From the nature of the crop, there is little danger to be feared from exclusive corn culture. The corn-grower is usually something of a stockman and feeds a portion, at least, of the product on the soil where it is grown. The character of the crop is such that its profitable culture is safe only on low lying soil. On upland, corn is at the mercy of the weather and lack of moisture at the critical period has in some years resulted in complete failure. On the contrary, corn on the bottoms has not yet failed to be profitable.

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Corn matures in August and an increasing proportion of the fodder is cut and shocked each year. Corn stover makes excellent roughage for cattle and the gain by cutting is large. The long period of hot, dry and frequently windy weather following the ripening of the corn destroys nearly all of the value of the fodder if left standing.

Much of the corn that comes to market is badly mixed showing lack of care in seed selection. No other crop is so readily susceptible of quick improvement as corn. Stalks and ears of individual excellence are easily found. The corn-grower should have an ideal type of corn in mind and go through the field when the crop is mature and select the kind of ears that he wishes to perpetuate. Tastes differ but seed from large ears with small cobs well covered with uniform grains and from stalks bearing two or more perfect ears is easily secured in this manner. This plan should be the regular method of selection of seed corn. The ears selected should be stored in a cool, dry place, sorted during the brief leisure of the cold weather, and the corn shelled in preparation for seeding. There is no need of paying high prices for seed from distant localities and tales of varieties that will yield, without fail, fifty, or seventy five or one hundred bushels per acre are fables in which the purchaser is left to find the moral.

COTTON.

A recent inquiry conducted by the station showed that fifteen acres was the average grown by eighty growers of cotton This was in Payne, Lincoln and Logan counties. In a few other districts, the average is perhaps larger.

Not every farmer will find it profitable to grow cotton as the crop is one that requires considerable hand labor. Its culture has, however, proven profitable to many and it is an important crop that if rightly used, will be permanently desirable.

Here, as with many other crops, sufficient attention is not paid to the character and purity of the seed. Selection and improvement of cotton-seed is a matter of some difficulty, and requires skill and patience. There seems to be a field here for the work of a few skilled cotton-growers who should have for their object the improvement and development of a type of cotton well-suited to this region. Several varieties of cotton differing widely in character may be developed from a single seed in the course of a few years. This tendency to variation makes the opportunity and the necessity for selection greater than with almost any other crop.

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The general plan of improvement consists in the selection of well developed bolls from plants of individual excellence both as to yield and quality of fiber. The cotton so selected should be hand-ginned and a sufficient amount of seed obtained to plant an area large enough to give seed for planting the entire crop the second year. Further selection should be made from the plants grown from the first selected seed and seed thus selected taken to grow the seed for the general crop the third year. The grower who improves his cotton in this manner will find but little difficulty in disposing of the seed from his general crop to others who don't go to the trouble that he does. This steady improvement should be kept up all the time and will result in larger yields of better quality in a very short time.

Cotton should be grown in rotation and not continuously on the same piece of land. It is a crop that draws heavily upon the fertility, and in time impoverishes the soil so that neither it nor other crops will give a profitable yield. If, however, it is grown once in three or four years on a given field, and other suitable crops are grown in the meantime, the soil has time to recuperate and is in better condition for a crop of cotton.

OATS.

Some modification of our present methods seems yet necessary before the oat crop can be relied upon. Weeds and rust seem to be the greatest difficulties in the way. It is possible to overcome the former in a great measure by sowing oats after one or two clean-culture crops, such as corn and cotton, have been grown on the land. In this way, weeds and grass are partially eradicated and the crop has a chance to cover the ground before they get a start. Early sowing of an early maturing and rust-proof variety is perhaps the surest method of avoiding rust. The Texas Red variety has yielded well at the station and is preferred by many farmers.

Oats is excellent feed for horses and the crop is desirable in a rotation, leaving the ground in good condition to be followed by wheat. The amount grown at present is insufficient for local demands and but little of it is shipped to market. An increased acreage would be profitable in many sections.

CASTOR BEANS.

The growing of this crop is confined chiefly to Logan, Payne and Noble counties, but almost every county has a small acreage. The

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extent of the crop in the counties named is due to the fact that it has been grown there for a longer time than elsewhere and probably not because of any special climatic or soil conditions. This crop could perhaps be extended with profit to other sections of the territory. It requires considerable hand labor at picking time but no special machinery for cultivation or preparing for market.

The seed should be planted during the latter half of April, the soil having had the same preparation as for corn. The rows should be from 3 to 3½ feet apart with one seed each 12 to 18 inches. Clean, shallow cultivation should be given until the ground is shaded by the plants. After this, no attention is required until the first crop of spikes is ripe. This stage is indicated by the drying up of the seed pods and the tendency of the bean to "pop out." Picking should be begun before the "popping" stage is far advanced. A box is fixed on runners and is drawn between the rows and the picker cuts off the ripe spikes and throws them into the box, taking two rows at a time.

After picking, the spikes are spread on a previously prepared piece of hard soil from which the weeds and grass have been scraped. The piles of spikes are forked over and placed in a thin layer so that they may dry rapidly. The beans "pop out" and may be cleaned by running through a fanning mill. Care should be taken that the beans do not become wet and in case of rain, they should be covered.

Three pickings are usually necessary, and some of the crop is unavoidably lost on the ground during the ripening stage. The seed-pods, or hulls as they are usually called, are equal in fertilizing value to wood ashes and form an excellent mulch and manure for fruit trees.

No part of the plant can be used as food for animals. Horses seem to have a special fondness for the beans and they must not be allowed to eat them. The beans contain a specific poison and horses almost invariably die from the effect of eating even a small amount of castor beans.

The profits from the crop are not large, twelve bushels per acre being an average yield, selling at seventy-five cents to a dollar per bushel. Those who grow it, however, think a small acreage of the crop each year desirable and profitable.

This crop is fully as susceptible of improvement by seed selection as any other. Selected seed on the station farm produced two bushels per acre more than unselected seed. Large spikes from vigorous plants of individual excellence are easily selected when the

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castor beans are being picked and kept separate for seed for the next crop.

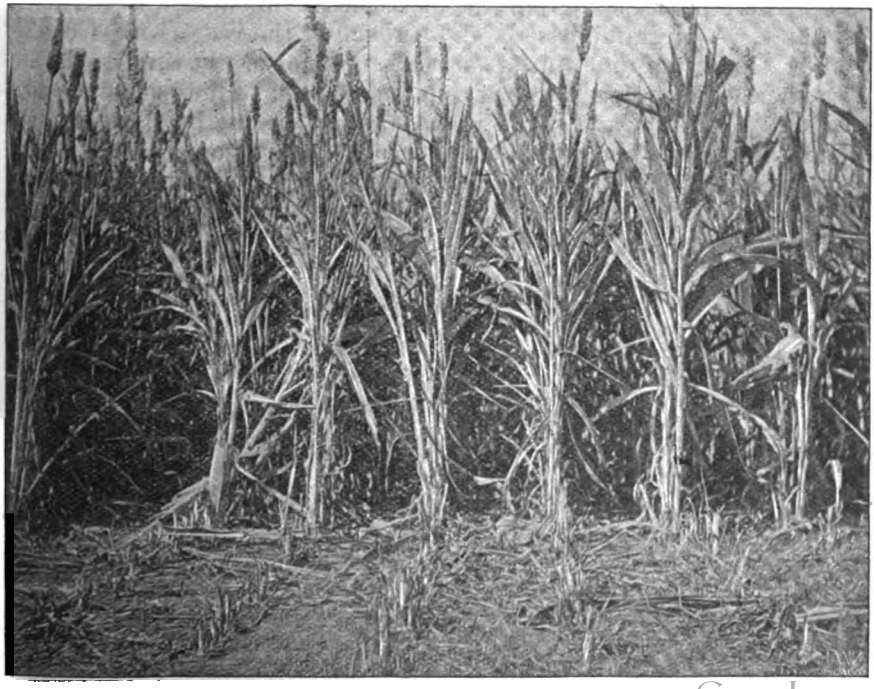
KAFIR CORN.

This is a comparatively new crop and one that is practically unknown to eastern farmers. It has much to recommend it to those in Oklahoma who have upland farms and is being largely used by them as a substitute for corn. It is well suited for this purpose. The absence of an outside market for the grain is an advantage rather than a hindrance as it makes stock-raising almost a necessity.

Black-hulled white Kafir is the variety usually grown in Oklahoma, though in Kansas, the red variety is preferred by some. Trials at this station have resulted favorably for the former.

Kafir when grown for grain should be planted closer than corn. For the average upland soils, it is probably best to plant in rows three feet apart with one stalk each three to five inches. At this distance, yields of from 40 to 85 bushels per acre have been secured on the station farm.

When grown for the forage, it should be planted much thicker. The accompanying illustration shows one desirable method. When



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grown in this manner, the crop may be cut by hand or by machinery and shocked until used. There are many unanswered questions concerning the best and cheapest methods of growing, harvesting, and feeding the Kafir crop. Farmers have had to feel their way in a large measure, though several of the published bulletins of this and other stations have reported results of quite extended experiments. It is probably true that on upland soils, more pounds of pork or beef can be produced by feeding the crop from an acre of Kafir than from an acre of corn. This is the case, even though the results of practical feeding and digestion trials have placed Kafir and its products nearly twenty per cent below corn in feeding value. A better understanding of methods of growing and feeding will result in reducing this percentage of difference very materially.

HAY.

The chief hay crop of the territory is made from the native grasses. None of the true, cultivated grasses have yet shown value for hay here. There are cases in which timothy has taken hold and given a light yield, but generally speaking, it has not succeeded. Little dependence is placed upon hay for feed on farms, and much that is made is marketed in the cities.

There is one hay crop that succeeds in Oklahoma, and that is alfalfa. A large increase in the acreage of the crop is most desirable. In saying that alfalfa succeeds, it is not meant that it will do so on all soils. Very hard, dry upland and very sandy soils are not suited to alfalfa, and while it may be grown on them, yields are light and a good stand difficult to secure. The amount of such land in proportion to the total area is, however, small and there are few farms on which some land may not be well used in alfalfa growing. (See summary of Press Bulletins, page 51.)

COWPEAS.

This crop, and soy beans as well, is not appreciated and understood as it should be in Oklahoma. Cowpeas take the place of clover and do it well but the crop differs from clover in being an annual. (See summary of Press Bulletins, page 48.)

SORGHUM.

Sorghum when sown thickly and cut for hay gives a large yield of forage which is rich in fat-forming but poor in growth-making

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materials. It gives a larger yield per acre than almost any other crops; but for growing animals, is not so nutritious as Kafir fodder and far inferior to cowpea or alfalfa hay. Its culture might well be confined to the poorer, upland soils, where it serves a useful purpose. Even on these soils, it is yet questionable if Kafir is not the more profitable.

The summary of digestion trials published in Bulletin No. 46 illustrates the main points of difference between sorghum and Kafir.

Sorghum may be used to good advantage to supplement pasture during July and August when the latter is frequently short. If sown reasonably early near to the pasture, it may be cut daily, allowed to partially wilt, and then hauled or thrown into the pasture, or feed lot. A succession of plantings may be made and used in this manner and will in most cases, give a fair yield of hay from the second crop.

MINOR CROPS.

Among the minor crops grown successfully in some localities are peanuts, broom corn, water melons, canteloupes, and garden vegetables. Success with the last named requires skill and close attention, but the efforts of the specialist are rewarded here as elsewhere.

FRUITS.

In the Summary of Press Bulletins (p. 54) will be found a statement of varieties preferred by Oklahoma orchardists. There is a growing interest in fruit production and the indications are that the industry will be found quite profitable. On page 116 will be found a list of varieties in the station orchard that have set fruit in 1900.

PASTURE GRASSES.

The native grasses are the best yet found for pasture in Oklahoma. This statement sums up the experience and observation of all who have given the subject close attention. Up to the present time, nothing has been found that may be sown with reasonable certainty of securing a good stand. English blue grass and orchard grass come nearest to being successful. The trials with Bromus inermis, or smooth brome grass, made at the station have not been sufficiently extended to determine its value, though it will probably be fairly successful. Most of Oklahoma is a little too far north for the successful growing of Bermuda grass, though it does well in sunny locations and is fair as a lawn grass. Kentucky blue grass requires much nursing and a good stand is exceedingly difficult to procure and maintain.

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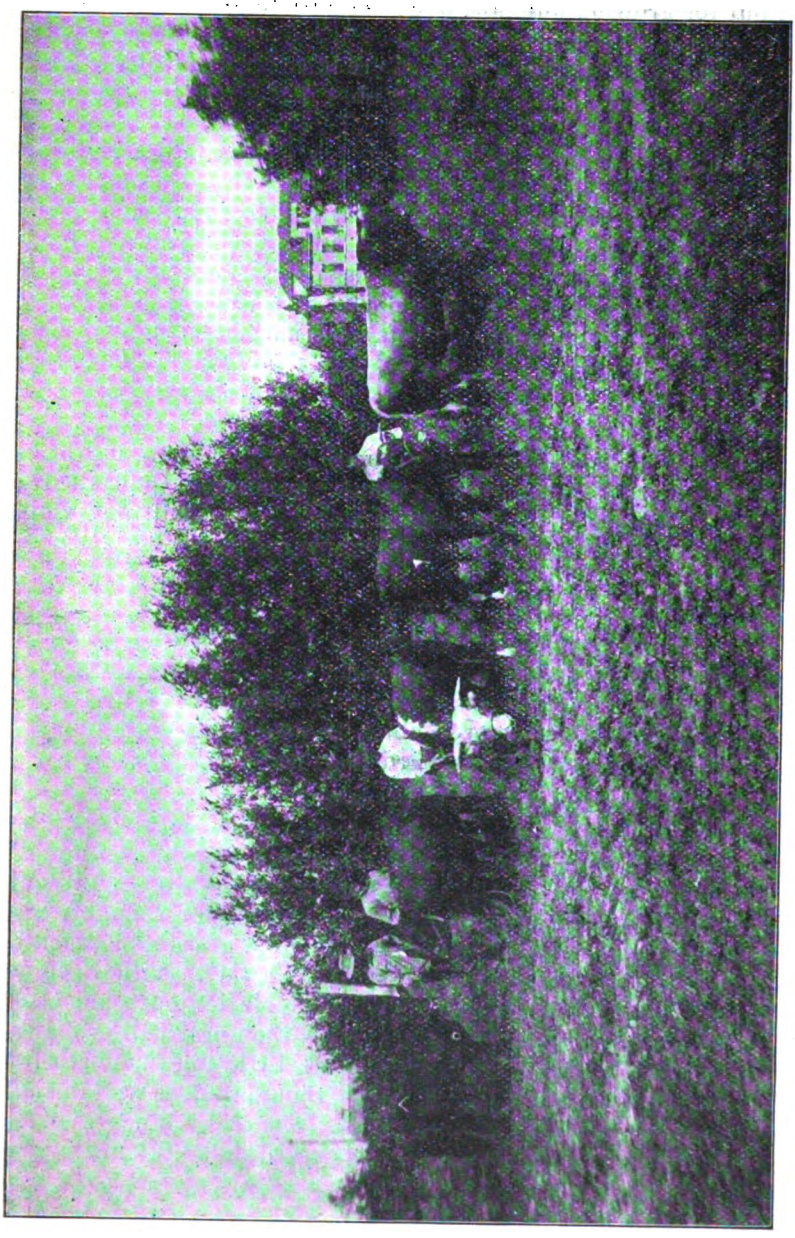

Angus Red Poll Hereford Shorthorn Jersey

PURE-BRED BULLS.

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Native grass pastures may be strengthened by keeping down the weeds and harrowing or disking the thin spots and seeding to some of the grasses mentioned above. The pasture land is a valuable asset of the farm and should not be over-stocked. It is better to have two pastures and use them alternately. The native grasses mature seed in succession from May to September and rotation in pasturing is necessary for re-seeding. This applies with special force to western Oklahoma where much dependence is placed on native pastures.

LIVESTOCK.—CATTLE, HOGS, HORSES, MULES, SHEEP, POULTRY.

No single factor will make more for the permanent success of agriculture in Oklahoma than a steady gain in the number and quality of the livestock reared and matured here. There is but one right way and that is gradual improvement by the introduction of pure-bred stock wherever and whenever possible. Even with poor foundation stock, it is possible to build up and improve the quality of the stock in a very few years if none but pure-bred sires are used for breeding purposes. The first cross is a half-blood, the next is three-quarters, and the next seven-eighths and practically as good for work, and beef, and pork, and mutton, and fried chicken as pure-bred animals. Farmers should co-operate in this matter and unite to improve their herds by the purchase and use of pure-bred sires and the absolute exclusion of scrub animals for this purpose.

HERD OF PURE-BRED COWS.

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Breeders of hogs are very active and the grade of hogs in the territory is excellent and improving rapidly. More interest is being manifested in the improvement of the grade of cattle, though there is yet much to be done.

Insufficient attention to horse breeding is manifest in the character of many of the horses. The mark of the broncho and Indian pony is much in evidence. The Percheron and Clydesdale and other breeds of horses for farm work and road service should be more frequently seen.

Sheep could be kept on many farms and be made to yield a good profit. The number of sheep in the territory is small and should be increased. Sheep have been kept on the station farm for a number of years with no losses from disease, and have proven quite profitable.

The poultry industry is well represented in the matter of breeders and poultry associations, but there is a lack of interest among farmers generally in this important feature of farm products. This should not be so, for the climatic and other conditions are such that poultry may be cheaply reared and sold at a good profit. A little thought and care in selection and feeding of chickens and in their marketing is well repaid. The station is beginning feeding experiments with chickens. Some results have been published in Bulletin No. 46, and others will follow later. The great trouble seems to be that poultry fanciers and farmers do not get together and work for their mutual interests. The local demand for poultry products is good and the supply insufficient at many times.

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SUMMARY OF PRESS BULLETINS.

A press bulletin is sent out from the station on about the fifteenth of each month. These bulletins are sent only to newspapers and are intended to contain timely topics related to the work of the station and the agricultural interests of the territory. They are printed in many of the daily and weekly papers of the territory and in agricultural papers elsewhere. The station is under obligations to those editors who have assisted in this manner and hereby gratefully acknowledges it. Some of the articles contained in the bulletins may have a permanent value and are reprinted in this report for convenient reference. They are, of necessity, fragmentary and, in part, a repetition of matter contained in regular station bulletins.

FARMERS' INSTITUTES.

In almost every state there is some arrangement by which aid is furnished to meetings called farmers' institutes. These meetings are for the purpose of exchanging experiences in the growing of crops and the rearing of stock and of the varied interests of farm life. It is the usual custom for the local organization to make all of the arrangements for the meeting.

It is customary to begin with a session in the afternoon of one day and close in the evening of the following day. It is generally advisable to devote the day sessions to matters of special interest, such as the discussion of affairs relating to farming, and to have something of a literary program with a lecture on an agricultural topic by some speaker from another locality in the evenings.

The Territory of Oklahoma has not yet provided for this important work and the experiment station desires to give all of the assistance that it can to farmers' institutes. The fund from which traveling expenses may be paid is small and it is necessary that speakers when sent out attend the maximum number of meetings with the minimum amount of travel. For this reason, it is important that communities desiring the aid of speakers from the college in holding their institutes make arrangements some time before

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hand. At least one, and when possible, two speakers will be sent to every institute, if proper arrangements can be made. There will be no charge for either traveling expenses or services.

December, January and February are good months for holding institutes. Let a number of farmers and others get together in each community, decide to hold an institute, elect a president and secretary, and write the particulars to the Director of the Experiment Station, Stillwater, Okla., who will arrange to give all possible aid to these meetings.

BOOKS FOR FARMERS.

There is a great deal of work being done in the study of matters relating to farming. Much of what has been done in the past is summarized and published in book form. These books cover a wide field and are worthy of study by farmers, young and old. The experiment station has prepared a list of books suitable for the farm library. The list is subdivided under the headings, field crops, livestock, fruit, and the home. By a special arrangement, great reductions from list prices have been obtained, and those desiring information and the list of books should send for it at once.

SOWING WHEAT.

At this season of the year every farmer who grows wheat is busy and will be getting busier as the weeks go by. It is in one sense a misfortune that our climatic conditions are such that it is possible to extend the time of sowing wheat until in December. This state of affairs has a tendency to keep a man from hustling as he should to try to get his crop in early. The average experience up to this time shows that wheat sown before the first of October may be expected to give a somewhat higher yield than that sown in October, and much higher than that sown in November or December. In some cases late sowing has given good yields, but the chances as calculated from experience are much against it. As much wheat as possible should be sown during September.

Last spring there was considerable loss from the wheat blowing out or becoming covered during the dry winds of the spring. This loss was not so great on fields where the soil was covered with

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a good growth of wheat. Early sown wheat that had not been too closely pastured and wheat that had been sown more thickly than the average, covered the ground to such an extent that the winds did not get a chance at the soil and did no damage. It is safer to sow six pecks per acre than it is to sow four or less. The extra cost of two pecks of wheat is usually returned in the increase in yield.

Farmers are coming to appreciate the fact that the manure which is produced about the stable and feed yard is of great value. Trials at the Oklahoma experiment station have always resulted in great good from the use of manure for wheat. Ten to fifteen loads per acre have practically more than doubled the yield and the effect continues to be observed upon succeeding crops. There is a section of Oklahoma where wheat now does remarkably well, and where the soil is being treated in such a way that it is not at all probable that it will continue to produce good crops of wheat. Great burning straw piles tell a story of improvidence and waste that is inexcusable. The straw, if dragged over the wheat field and plowed under, would in many cases nearly double the yield of wheat and improve the condition of the soil at the same time. While the amount of fertility in the soil is the limit of its ability to produce a crop, the mechanical condition or tilth is of as much importance. Many sections of this country are now unproductive, not for the reason that the soil has been exhausted of plant-food, but for the reason that the soil is hard and cold and unfit for the growth of crops. And the soil was gotten in this shape by exactly the same sort of treatment that many Oklahoma wheat farmers are giving to their soils.

KAFIR FODDER.

There is quite a difference in opinion as to the best method of handling Kafir fodder when it is planted thickly, and is to be used for feeding and wintering stock cattle. In general it is believed that the fodder should be cut and placed in small shocks when the grains have passed from the soft stage and become firm. The fodder will yet be green, and if put in large shocks will spoil, but will be excellent feed if properly shocked. In feeding it when prepared in this way the amount given should not be more than the

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cattle will eat up reasonably clean, if too much is given they will eat only the heads and waste a large portion of the fodder.

COWPEAS.

The cowpea belongs to the great order of plants called legumes that have the power through the aid of microscopic organisms of using the free nitrogen of the air in their growth. The crop is thus a soil renovator and builder and leaves the land much richer after a crop of cowpeas has been grown upon it, even if the vines are re-removed as hay. In addition to the above valuable qualification, the grain and vines contain a large proportion of that important ingredient, protein. This is the material that makes growth and is so essential in all food stuffs for young, growing stock and dairy animals to make them do well and yield their owner profit. Hence the crop has two very valuable points in its favor. Much has been said in the past of the great adaptability of the crop for Oklahoma, but still it is grown to a limited extent only. In small areas, at least, it should have a place in the regular crops on every farm. The crop can be utilized to greatest advantage by pasturing off with cattle, sheep, or hogs. In this way almost all of the valuable fertilizing ingredients are returned at once to the land.

The difficulty of properly curing the hay bars the use of the crop for this purpose to any great extent when it can be used otherwise. It is, however, advisable to put up a small stack of hay to use in special cases, and it will be found of much value. As an example, at the Oklahoma experiment station, shoats weighing about 115 lbs. at the beginning of the experiment were divided into two lots. The first was fed what cowpea hay the pigs would eat in addition to a mixture of one-half Kafir and one-half corn meal. They consumed four and three-quarter pounds of grain for each pound of gain while another lot fed the same kind of grain but no cowpea hay consumed eight and one-fifth pounds of grain for each pound of gain. The lot receiving cowpea hay had a better appetite, ate more grain, and made better gains than the lot that did not receive cowpea hay.

This is only one of the many examples that might be cited to show the value of cowpea hay when fed properly. Used in ways similar to this it is found to be an exceedingly valuable material.

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While a very valuable crop to plow under for green manuring, in the majority of cases, it will pay best to first pasture it off with stock.

The crop may be planted at any time from after corn planting until after wheat harvest and in some cases later. It should be used more as a catch crop than it is, for instance after wheat and oats. At the Oklahoma experiment station, the wheat stubble is opened up with a lister and the cowpeas drilled in the furrow. They are given little or much cultivation as time affords and a fair growth of vines is obtained. The land was enriched and cultivated and not left to grow up to weeds and seed the land. With little preparation, it was ready for another crop.

Cowpeas do well either in drills or broadcast. In drills about two and one-half feet apart, two to three pecks of seed per acre will be required. Of the many varieties, the whippoorwill, or speckled, is the most suitable for general use in Oklahoma. For special cases, other varieties may give somewhat better results. It takes time to build up a soil by growing crops on it, but it may be done in this way and is certainly the most economical method. At first large yields, even of cowpeas, should not be expected on very poor soil.

PEANUTS.

There are sections of Oklahoma in which the growing of peanuts for market has been quite profitable. While it is not desirable to engage too extensively in the production of any single crop, any addition to the number of profitable crops grown is an advantage as it leads to greater diversification and safer farming.

Hard soils are not suited to profitable peanut culture. Sandy soils that are sufficiently moist, and loose loams are preferable.

The soil should be prepared as for corn or cotton and free from clods, roots, corn stubble and other rubbish.

The seed should be hulled before planting. About two bushels of nuts in the pod are required for an acre, and in hulling, the skin of the kernel should not be broken and all imperfect kernels should be rejected.

The time of planting must be determined by the character of the season and should be delayed until all danger from frost is past.

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The planting may be either in drills or check rows. Three feet between the rows and two seeds every 12 to 16 inches is perhaps the average.

A sufficient amount of cultivation must be given to keep the soil free from weeds but more is unnecessary. Both level and ridge cultivation is practiced though it is questionable if ridging is necessary. Higher yields are usually obtained from level cultivation, especially in dry seasons.

A special plow arranged to cut the tap-root of the vine and loosen the soil is necessary. The vines with the peanuts attached are then forked into windrows. If the weather is dry there is no need of stacking the vines, but if it rains the quality of the crop will be injured. In two to three weeks the pods are ready to be picked or thrashed. Hand picking was formerly practiced but it is slow and tedious. Peanut thrashing machines run by horse or steam power are more economical and unless the use of such a machine can be obtained, it would not be profitable to grow the crop.

The vines have a high feeding value approximately equal to that of alfalfa or cow pea hay. Peanuts afford a very nutritious diet for hogs. If planted for hog pasture, it should be in an enclosed space so that the hogs may harvest the crop after the pods have matured.

The peanut belongs to the same class of plants as clover, alfalfa, and cow peas and does not, if properly handled, draw heavily upon the fertility of the soil.

COTTON IN OKLAHOMA.

The Oklahoma Agricultural Experiment Station has conducted an inquiry concerning the cotton crop in parts of Noble, Lincoln, Logan, and Payne Counties. Eighty farmers in these counties were interviewed and the results of their experience and observation with this crop have been summarized. Ten per cent of this number regarded the growing of cotton as unprofitable. The average area devoted to cotton was fifteen acres and the yield during the fall of 1899 varied from 500 to 800 lbs. of seed cotton per acre. This cotton was sold for $1.90 to $2.20 per hundred pounds with an estimated profit of from $5 to $10 per acre. The yields this year

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were about two thirds of what was secured in 1898, but the difference in price made the profit per acre about the same. Many farmers regard the crop as one which is desirable to provide work that the children can do, but deplore the fact that cotton picking frequently keeps the children out of school.

Sandy or sandy loam soils are given the preference and there is a strong belief in the value of manure on cotton soils. The time of planting varied from April 15 to May 15 with no traceable effect on yield from difference in time of planting. The cotton was usually chopped to one stalk each eighteen inches with rows three to three and one-half feet apart. The average number of cultivations given was three with preference about equally divided between level and ridge culture. The advantage of thorough, shallow cultivation and clean culture was noted by many. The average number of pickings given was three.

It is the general opinion that the growing of a limited amount of cotton will prove continously profitable. This crop has its place in the great diversification of crops possible here and there seems to be no tendency toward making the great mistake of going into exclusive cotton culture.

ALFALFA.

Experience with this valuable hay crop has shown that it will thrive in many sections of Oklahoma and the acreage of it should be increased. A careful survey of the reported failures leads to the conclusion that too close pasturing has been the usual cause. Many fields of alfalfa have been ruined by this method, while fields close at hand that have been cut for hay and pastured but little are in excellent condition.

Alfalfa has a long tap root and will not do well on soils with hard-pan close to the surface. It thrives best on soils that have been plowed deep and well cultivated. Early plowing for spring sowing is an advantage as it gives the soil time to settle and become filled with moisture before sowing. The seed should be sown as soon as the soil is in good condition in the spring. When the plants are about six inches high they should be cut with a mower set high, and this operation repeated at intervals of two to three weeks until the weeds are left behind the alfalfa in growth. This

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method proved successful at the station last season. There are some objections to it and sowing late in August has sometimes proven better. If wheat ground is plowed early in July and the weeds kept down by frequently harrowing, and the seed sown after the soil is filled with moisture, a good stand of alfalfa free from weeds may be secured. Trials of the Turkestan alfalfa imported by the U. S. Department of agriculture are being continued by the station.

Alfalfa should be cut for hay in early full bloom and not allowed to ripen. Cut at this stage, the next cutting is larger and the plants are better than when cut at a later period. Three cuttings of one ton per acre each have been secured on the station farm and the alfalfa plats at the present time are in good condition.

Continued effort should be made to increase the acreage of alfalfa in the territory. This should be regarded as a crop for hay rather than for pasture. Spring sowing on clean, well prepared soil, has in many cases given good results. If sowing at this time fails, it may be repeated in August or early September which is the most favorable time for fall sowing.

BROOM CORN.

The high prices received last year for this crop have caused a renewal of interest and many with no experience are thinking of growing it the coming season. The growing of the crop is a comparatively simple matter but the curing and marketing is more difficult. It is usually planted with three to four stalks every fifteen inches in rows three to four feet apart.

The corn is harvested before the seed is fully ripe. The tops are broken off about eight inches from the head and the seed is removed by a stripper. The brush is allowed to dry in sheds under cover, as rain greatly injures the quality. When dry, the broom corn is baled and marketed. A large increase in the acreage will naturally result in a fall in price. One fourth of a ton of cured broom corn to the acre is a fair yield.

WEIGHT OF KAFIR CORN.

A bushel of Kafir corn, fairly well cleaned, weighs fifty-six lbs., and this is the legal weight adopted in Kansas; but this point

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has not been passed upon in Oklahoma. The above is pretty generally known, but what weight of heads is necessary to make a bushel of grain, and how to ascertain the amount of grain in the heads by measurements are questions very frequently asked. The last two questions are not so easily answered and considerable judgment must be exercised in each case in determining the proper answers. Are the heads with stems from eight to twelve inches long, containing more or less leaves, or are they cut close and free of trash? Are the heads, to be measured, lying loose in a box, or have they been tramped in or settled by a long haul? Referring to data obtained in thrashing out several hundred bushels of Kafir corn from weighed heads, and extending through several seasons, the percentage of grain in a hundred lbs. of heads varies from 20 to 35 per cent. This would mean from seventy-five to eighty lbs. of heads are required to produce a bushel of grain. The average runs about 30 per cent., or about eighty lbs. of heads to produce a bushel of grain. The maximum amount was obtained in a case where the heads were large and well developed, cut close and well cured. The minimum amount of grain was obtained where the heads were rather small with long stems, and not well cured, having some leaves among them. The past fall the station has received some 300 bushels of Kafir corn in the heads, and the heads were weighed before and the grain after thrashing. Eighty lbs. of the heads were required to produce fifty-six pounds of grain, with very little variation.

Roughly, every two inches in a common wagon box, "120 inches by 36 inches by 41 inches deep," contained one bushel of grain. This determination was made with but one man's Kafir, consisting of seven loads. In this case it was tramped in the wagon as loaded, and then hauled several miles.

NEW PLANTS.

The enthusiasm of seedsmen frequently leads them to make statements in their catalogues that are not borne out by actual practice under all conditions. A given forage crop may produce abundantly under favorable conditions in a climate very different from that of Oklahoma. A forage crop that does well here may yield very poorly elsewhere. For this reason, farmers everywhere should be cautious before buying largely of untried seeds and plants. There is an experiment station in each state that is on the watch for new

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and good things and these stations are in a position to know the truth about such things. The Oklahoma Experiment Station is located at Stillwater and inquiries of any sort concerning farm topics are always cheerfully answered.

Of the great number of grasses tried at the Oklahoma Agricultural Experiment Station, the most promising for pasture are English blue grass, orchard grass, and possibly bromus inermis. The experiment station has no seeds or plants for distribution or sale.

FRUITS FOR OKLAHOMA.

The Experiment Station has issued a bulletin bearing the above title. It consists of a summary of reports received from men engaged in fruit growing in different sections of the territory, and contains lists of varieties of different fruits and methods that have done best up to this time.

Below is given a brief sumary of the preferences expressed by the majority of those reporting in each instance.

Apples:—Missouri Pippin, Ben Davis, Winesap, Johnathan, Arkansas Black, Maiden Blush, Mammoth Black twig, Cooper's Early White, and Yellow Transparent are given as the most desirable varieties for general planting.

Pears:—The reports indicate that pears have done well in almost every case where they have had good cultivation. The following varieties are considered the most desirable;—Kieffer, Bartlett, Duchess, LeConte, and Garber.

Peaches:—This fruit has done well in Oklahoma and the reports received show marked success with it. While a great many varieties are grown, the following were given the preference by the largest number of growers:—Elberta, Alexander, Crawford's Late, Crawford's Early, Heath Cling and Salaway.

Plums:—Reports were received from twenty-four orchards representing ten counties. They place plums nearly if not quite at the head of the list of fruits for Oklahoma. The following list contains the varieties thought most desirable:—Wild Goose, Abundance, Burbank, Wickson, and Marianna.

Cherries:—The sweet varieties do not seem profitable in the western counties but sour cherries are reported as having borne good crops on almost every kind of soil and location. The following

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varieties were recommended for general planting:—Early Richmond, English Morello, Montmorency, Mayduke, Dyehouse, Gov. Wood, Ostheim, and Olivet.

Grapes:—This fruit has received much attention at the hands of fruit growers and the vineyards of the territory have become one of its chief objects of pride. Quite detailed reports were received and, while many other varieties were mentioned, the following varieties were given the preference for general purposes:—Concord, Catawaba, Niagara, Moore's Early, Worden, Moore's Diamond, Delaware and Goethe.

Blackberries:—Some of those reporting consider this the most paying fruit crop while others consider it a failure. Early Harvest, Kittatinny, and Snyder are the varieties preferred by most of those reporting.

Apricots:—No reports were received concerning this fruit. The varieties planted in the station orchard are given in the bulletin. A full crop of apricots is rarely obtained, the late spring frost killing most of the fruit.

Currants—The Crandal currant is reported as having been grown with a fair degree of success.

Raspberries:—This crop is not regarded as a desirable one unless it is possible to help the natural supply of moisture by irrigation. The Turner and Cuthbert varieties have grown well but have not yet produced a satisfactory crop here.

PREPARE FOR CHINCH BUGS.

The chinch bug we have always with us and it is well to prepare for him in advance. This may be done with little trouble if begun in time. Last season, the following method was successful at the Oklahoma Experiment Station: A drive extended along the west side of the wheat field; next to this drive was a narrow strip of castor beans and then a few rods of cotton and next to the cotton four of sorghum. Cowpeas were listed in the wheat ground as soon as the wheat was cut, which destroyed some bugs. Many escaped, and went across the drive, the castor beans, and cotton to the sorghum. When they had well collected on this, four rows planted as a "trap crop" were plowed under very deep and rolled down hard. Beyond this strip were a few rows of cotton and then four more rows of sorghum also planted as a "trap crop." The bugs

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that escaped from the first trap passed on to the second and when they had collected in this second strip it was plowed as the first and thereby nearly all the bugs were completely destroyed. A few more rows of cotton were planted beyond to the west of the second strip that was plowed and then Kafir, which was saved from the bugs. This may often be done in a similar way if the crops are planted with this in view.

The few bugs that escape such vigorous treatment as this should be infected with the chinch bug disease. Those who wish infection should send a small package of bugs to the Agricultural Experiment Station, Stillwater, Oklahoma, and will receive in return a package of infected bugs with direction for spreading the infection. This should be done early and before the bugs begin to destroy the crops.

STORING POTATOES.

The horticultural department has been conducting experiments in the growing and storing of potatoes during the present season. While it is yet too early to say with certainty that any given method will prove far superior to any other, some results have been obtained which indicate the following to be cheap and fully as effective as anything else tried: After digging the potatoes, those which show evidence of decay should be rejected, and the sound potatoes packed in boxes with dry sand in a sufficient amount to just prevent the potatoes from touching each other in the boxes. The boxes should be placed in a cool, dry cave, freedom from moisture being particularly desirable. While the station does not recommend this as an absolutely certain way of keeping potatoes, it advises the trial of it on quite an extended scale.

SHADE TREES.

Those who fail to set out shade trees during the fall should prepare now to do so in the spring. At the Oklahoma Experiment Station, in one experiment on a hard soil, the following method resulted successfully:—Holes three feet in diameter and three feet deep were dug in the early winter and allowed to remain open so that the soil could weather and become porous. In February, three forkfuls of well rotted manure were put in the bottom of the holes

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and on top of this, two shovelfuls of leached ashes. This was then covered with surface soil and the holes filled in to within about a foot of the top. This was then allowed to settle and become firm before the trees were set. The trees were set out in March and the soil within three feet of the trees was hoed after every rain during the summer. Maples and locusts were planted and they made a vigorous and rapid growth. While this method is perhaps too expensive to be used for extensive plantings, it is recommended for use in towns and about the house and lawn. Whatever method of planting is followed, little success will follow unless the soil is thoroughly cultivated and the surface kept free from grass and weeds.

GRASS FOR LAWNS.

The experiment station receives numerous inquiries concerning grasses best suited for lawns. Numerous trials have been made with most every sort of grass, and the experiments of others have been carefully watched. Bermuda grass is perhaps the most likely of the tame grasses. In general it will grow well from sods set out at any time from April to July. One strong root to each square foot will give a good sod in one season. The soil should be as free as possible from weeds and crab grass, and should be firm and solid. Loose soil does not seem to be desirable. While the last severe winter killed Bermuda grass to some extent it has stood the summer reasonably well and is perhaps the most valuable grass for a lawn, particularly where irrigation is not practicable. It has a slight tendency to get over into the adjoining property, but as it does not produce seed in this latitude it is easily controlled, and it will grow.

WEEVEL IN WHEAT.

Considerable complaint is received at the experiment station that the weevel is injuring stored grain, particularly wheat. This can be stopped by the use of a liquid known as carbon bisulphide. As purchased at the drug stores, the liquid costs about twenty-five cents per pound but can be purchased in quantity at about ten cents plus transportation. The liquid evaporates readily at ordinary temperatures and the vapor being heavier than air, sinks and is death to all animal life that breathes it although a small amount

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taken into the lungs does no injury. The gas is also highly inflammable and therefore not even a lighted tobacco pipe or cigar should be brought into contact with it for fear that an explosion may result.

To use the gas the grain to be treated should be in reasonably tight bins. The gas will not penetrate more than about three feet in depth if used in wheat and it should therefore be introduced into the central part of the bin by fastening a wire screen over the end of a pipe of sufficient length and forcing the pipe down and pouring the liquid into the pipe when it may be withdrawn and forced into another place. If the weevil is working on or near the top, the liquid may be poured onto the grain and the bin covered with blankets or canvas for about 24 hours when the gas will have nearly or quite all disappeared. The gas does not injure the grain for growing or milling purposes.

GRAPE LEAF FOLDER.

Many vineyards have been seriously damaged by the grape leaf folder during the past season. In some places the vineyards have the appearance of a fire having passed through them, the leaves being parched and the grapes spoiled by exposure to the sun. This insect passes the winter stage in the dead leaves and vineyards which have been affected should be gone over and the leaves gathered up and burned, thus destroying large numbers of the insects. Next season at the very first appearance of the insect the vines should be sprayed with Paris-green, Bordeaux-lime mixture, as advised in bulletin 26, of Oklahoma Experiment Station, which is sent free to all who request it.

ROOT-ROT

Those who have lost apple or other trees are requested to write the facts to the experiment station. A study of a very destructive root-rot is being made and all possible information concerning the extent to which it has appeared in the territory is desired.

COOKING FEED FOR STOCK.

There is danger of some farmers being misled by the extravagant claims that are put forth by manufacturers of different appara-

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tus for cooking feed for stock. Many alluring statements are made and plausible arguments deduced to convince the possible purchaser that a great saving in feed and larger gains may be secured by cooking feed for hogs and cattle. If cooking feed is an economical practice, the farmers ought to know it, and if the reverse is equally true, they should know that.

The Oklahoma Experiment Station has not conducted any experiments in cooking feed for stock. This has not been necessary as records of experiments made elsewhere are available and the results are as true for Oklahoma as for anywhere else. These experiments have been summed up by Prof. Henry of Wisconsin in his book on "Feeds and Feeding," from which what follows is taken. Numerous experiments in feeding cooked and uncooked feed to pigs were made in Kansas, Iowa, Ottawa, Ohio, and Wisconsin. Prof. Henry summarizes these trials as follows:

"Including all the trials, then, so far as known that have been favorable to cooking feed, and omitting many, for lack of space, that are unfavorable to the operation, the average shows that 476 pounds of uncooked meal or grain were required for 100 pounds of gain with pigs, while after it was cooked 505 pounds were required. This shows a loss of six per cent. of the feeding value of these substances through cooking." In Maine, "The results have in every case pointed to the superior value of uncooked meal for the production of pork."

Looking at the whole matter of cooking feed in the most favorable light, the best that can be said is that "The advantages are very slight and not worth the trouble of either building the fire, cutting the wood or erecting the apparatus, to say nothing of all these combined, with danger and insurance added."

BLACK-LEG.

This is one of the most important diseases among cattle in Oklahoma and is commonly known as black-leg or black-quarter. The disease may assume a number of forms but usually is noticed as a local swelling in either the front or hind limb. This swelling contains gas which causes a crackling sound when the hand is passed over the swelling. The swelling is at first hot and painful, but after the gas begins to form it is not sensitive and the skin becomes dry and parchment-like. The disease is one common to

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young cattle and is rapidly fatal, death generally ocurring in from twelve to thirty-six hours after the first symptoms are noticed.

There is no successful medical treatment for the disease. Vaccination is now recognized as the most successful way to prevent the disease. The necessary apparatus consists of a hypodermic syringe, a small porcelain mortar, glass rod and filter funnel, and can be purchased from any instrument dealer. With this apparatus any careful individual can do the work successfully.

Those who wish information concerning black-leg should write to the experiment station. Many farmers and stockmen have lost cattle by this disease and the station is trying to prevent further losses and to do this, needs the co-operation of all the stockmen in the territory.

OKLAHOMA HONEY.

The experiment station for the past year has been experimenting with bees in the hope of determining whether or not Oklahoma offers a promising field for this industry. During the season the bees have increased from three colonies to eight, all in good condition. The amount of honey which has been secured is very small, but is of an excellent quality. A pure, imported Carniolan queen was recently introduced into one colony.

SUGAR BEETS.

Experiments in the growing of beets in Oklahoma for the production of sugar have been carried on for two years by the experiment station. Beets were grown by farmers in different parts of the territory and sent to the station for analysis. The results so far have not been at all favorable. The work is being continued this year. The government report on the progress of the beet sugar industry recently issued reports analyses of six samples from Oklahoma. It states that "both the content of sugar and the purity were below the minimum requirements. Oklahoma is evidently south of the beet area."

THE MELON LOUSE.

During the summer this insect feeds on melons, cucumbers, cotton, mustard and perhaps other plants. It is altogether probable

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that the insect passes the winter either in eggs laid late in the fall or the female survives the winter. The eggs or insects are located on some plant on which they may feed in early spring. This may be on the foliage of some plant that keeps green during the winter, or on the roots of some plant that loses its foliage in autumn or the eggs may be deposited on the plants or fruit late in the season. The plants themselves may die or the fruit may decay, as the melon and yet the eggs may survive. When warm weather comes in the spring if the eggs survive the winter they hatch and probably live for a time on some wild plant until they obtain wings. If the winged form has passed the winter it feeds for a short time on some wild plant. In either case when the melons have formed a few leaves these winged female forms fly from place to place over the field leaving, not eggs, but live young on the plants they visit. By careful observation it has been seen that one female individual will produce 5 or 6 live young in 24 hours and that these young having inherited the reproductive propensity, begin producing young at a similar rate in less than a week's time. Hence it will be seen that a single female louse that has successfully passed the winter can in a comparatively short time establish several colonies in the field. By a brief mathematical calculation it will be seen that one individual may become the common parent of a million or more in a single season.

From this it will be seen that preventive rather than curative measures should be employed. Could the few that are trying to pass the winter be found the destruction would be easy enough. The best thing to be done is to destroy the probable abode. This can best be done by destroying all old decayed or immature fruit by letting hogs eat it if practicable. If not then it should be hauled off a safe distance from the melon field and dumped. The old vines should all be raked together and burned if possible, if not then hauled away from the field. After the field has been cleared in the fall as soon as possible after the crop has been harvested, it should be well plowed and if after that any green thing tries to grow, it should be killed by harrowing or digging, for it may be that a very few living plants on a large field may harbor the enemy we are after. A second measure of precaution would be to burn at some time during the winter as much as possible of the weeds and grass for several rods around the proposed field. Since the louse is known to feed on the cotton plant it would be best to avoid as far as possible old cotton fields. But what is the melon grower to do

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who has not taken care of his field during the winter? Careful watch should be kept for the colonies that have started and when they are found, destroy the lice entirely even at the sacrifice of a few hills of melons. The fight should begin in the fall and be kept up until the crop is planted in the spring and longer if necessary.

VALUE OF STABLE MANURE.

Too many Oklahoma farmers are neglecting the improvement of their soils and are following the worst possible methods of farming. They are also missing an opportunity which, when once passed by, will not come again. Our soils are at present fertile and productive but they will not be so always.

On the outskirts of every town in Oklahoma may be seen a collection of manure piles that have been hauled out and dumped in waste places. The plant-food in each ton of this manure is worth at least two dollars—that is what eastern farmers pay for similar material and they make money by doing it. And yet, almost every liveryman has to pay some one for hauling the manure away. This is simply because farmers living near these towns are missing a chance to secure something for nothing—because perhaps the profit is not directly in sight. But from most soils there is a handsome profit possible from a very small application of stable manure.

On the farm of the Oklahoma agricultural experiment station is an acre that has been in wheat for eight years. It had never been manured. In the fall of 1898 one-half of the acre was manured at the rate of fifteen tons per acre and the other was left unmanured. When the crop was harvested in the summer of 1899, the manured piece yielded at the rate of thirty bushels per acre, and the unmanured yielded but twelve bushels per acre. An increase of eighteen bushels of wheat was secured the first year from an application of fifteen tons of stable manure. If all of the effect of the manure were exhausted the first season there were eighteen bushels of wheat to pay for hauling about ten loads of manure. But the effect is lasting and extends through a period of several years.

If the yield from one hundred acres of wheat could be increased in one season from 1200 to 3000 bushels by using some special sort of plow, or drill, wheat growers would be mortgaging their crop

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to get it. Here is a feasible plan to increase the wheat crop—put every bit of manure obtainable into the soil. Eighteen hundred bushels of wheat will pay for one man and team hauling manure for 450 days and the profit is directly in sight. It is a neglected opportunity for money making that can only be utilized by those who seem determined to neglect it—the owners of the farms of Oklahoma.

CULTIVATION.

While there are many questions in connection with the relation of soils to moisture that are not well understood, it seems quite well established that the chief thing that is necessary for the growth of good crops is to keep the soil cultivated. Primarily, the object of cultivation is to keep the moisture from being lost, either by evaporation or through the growth of useless plants. Weeds use a large amount of the water that ought to go to the crop that is being grown and it is fortunate that in killing the weeds, the surface of the soil is put in good condition for retaining moisture already present in the soil and absorbing that which falls in the form of rain.

There is no new method and none will be found by which crops may be grown without work and by which moisture may be produced in some mysterious way. It is a fact, however, that there is less evaporation from the surface when the soil is loose on top than when it is hard and compact all the way down. The reason for this is that the loose soil acts as a mulch through which the moisture from below will not pass and evaporate. The practical method that is open to Oklahoma farmers is to keep the surface of the soil loose, cultivating as soon as possible after the soil has been compacted by heavy rains. This plan will keep the water in the soil for the use of the crop that is growing. The implement which will do the work most economically is the best, and must be determined by what is available for the purpose.

Crops are grown for the money that may be made out of them. A special method that costs more than the crop is worth is worse than useless, but neglect of a crop when once planted is equally unadvisable. There is a happy medium which each farmer must determine for himself, even though the method that is pursued seems to be at variance with the best practice.

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POISON THE POCKET GOPHER.

The pocket gopher, which does so much damage to meadows and alfalfa fields by throwing up numerous mounds of earth, is causing trouble in some parts of Oklahoma. This pest is easily and cheaply eradicated by poisoning. Generally where there are three or four dozen mounds, one to four gophers are doing all the work. When they are not checked in any way, a whole field of alfalfa is sometimes destroyed.

Rough-on-rats or strychnine are good poisons and either sweet or Irish potatoes may be used to induce the gophers to eat the poison. The potatoes should be cut in quarters, a slit made in each into which poison is introduced by dipping a knife blade into the poison, sticking it into the slit made in the piece of potato, and then closing up. The potatoes are then taken to the field and the underground runs of the gopher found by punching a rod into the ground in a line between two freshly made mounds. When the run is found, which is indicated by the rod going down easily, make an opening into it with a spade, put a piece of the poisoned potato into each end of the run, and close the opening. The mounds should be leveled so that new ones may be easily seen.

This operation should be repeated for every group of mounds and doing it once, if the work is well done, is usually sufficient. Fall or early spring is the best time for the work.

Gophers may be trapped by making an opening into the run large enough so that a steel trap can be set in the run level with the bottom. The trap should be covered lightly with dirt and the opening closed with a board which is covered with dirt so as to exclude all light. Persistent effort using either of these methods will result in the killing of the gophers and the prevention of losses in alfalfa fields.

INSECTS AND REMEDIES.

Injurious insects seem to be present in unusual numbers this season. The experiment station at Stillwater will help what it can toward their control, but every one interested should make it a point to study out means of combat for themselves, often using very vigorous measures because it is frequently a week before a reply from a letter addressed to the station can be received, and during that time the insect may do several dollars worth of damage.

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Cut Worms.

The cut worms are very abundant this season, eating all kinds of garden crops and alfalfa and even climbing trees and destroying fruit and foliage. The remedy to be applied must depend largely on the nature of the food plant. In gardens poisoned bait consisting of sweetened, poisoned bran may prove effective. For trees, they should be jarred to the ground and something tied around the stem of the tree over which the worms can not climb. On alfalfa, spraying so as to poison the food or to kill by contact by the use of kerosene emulsion may prove effective, depending upon conditions. In all cases if poultry can be coaxed to eat the worms it is the best way of getting rid of them.

Chinch Bug Infection.

The experiment station is distributing chinch bug infection to all who request it. In several cases it has been found already established in fields either from previous distribution from the station or naturally. Where bugs are plentiful it will pay every farmer to investigate a little and see if the infection is not already in his crop before requesting more. It will be found under loose earth or dead leaves or between the leaf sheath and the stem of the plant. It will be recognized as nearly white, moldy growth on dead bugs, sometimes nearly covering the bug. It can be easily distinguished from the silvery spots on the wings. If this is found in comparatively small quantities the bugs in the field are in the presence of infection as well as they can be.

Grain Louse.

Many inquires are received at the station in regard to a small green insect found in the heads of wheat. They are not found in some wheat, but in other places they are very numerous nearly covering the heads of wheat. The pest is not so serious as it might at first seem. Either in the egg or mature stage the louse passes the winter and in spring begins to multiply very rapidly by certain individuals bringing forth young alive. In a week to ten days this new generation begins to reproduce so that in a comparatively short time thousands may be the descendants from a common single parent. Their attack on the wheat is so late that probably but little damage will be done anywhere. The wheat would certainly be better off without them for they suck out the juice that properly belongs to the plant and should go to mature the grain. In some fields there are none and in others it is possible, judging from

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the reports that have come in, that the yield may be reduced 1 to 3 per cent. There are remedies that might be used on a small scale but nothing that is practical on large fields of wheat at this season.

Brown Louse.

Many plum and locust trees are infested with a brown louse. They work chiefly on the underside of the leaves and on twigs. The lice should be carefully sprayed with kerosene emulsion made as follows: Dissolve 1½ pounds soap in a gallon of hot rain water and when cool add two gallons of coal oil and agitate vigorously until a creamy mass is formed; use one part of the emulsion to nine parts of water for all sucking insects. Apply in a fine, even spray so as to wet the insects thoroughly. A second application may be necessary.

THE PEACH LEAF CURL.

This disease is much more abundant this season than usual in the territory. The symptoms are a curling and yellowing of the leaves, due to the presence of a fungus on them which destroys the green color and cause the leaves to grow into abnormal shapes. The fungus may often be seen as a light mildew. A part of this fungus makes its way into the young buds which are already forming for the next year's growth. In this place the fungus passes the remainder of the year and is ready to start into growth as the leaves develop the following spring. No opportunity for experiments on this disease has occurred at this station, but extensive work has been done by W. M. Scott in Georgia on the same disease with the result that Bordeaux mixture made as follows, has proven successful:

1. Dissolve six pounds of blue stone in six gallons of water in an earthen vessel.

2. Slack four pounds of fresh lime in six gallons of water.

Pour 2 slowly into 1 and add twenty gallons of water. Mix thoroughly and strain through coarse gunny-sacking into a barrel. Reject the undissolved material and add eighteen gallons of water and the mixture is ready for use. The mixture will keep in this condition as long as desired.

This should be applied to the trees with spray pump just before they come into bloom. One application is usually sufficient if made at the right time. In orchards that have not thus been treated th

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disease may be slightly checked by spraying with the same mixture, but leaves that have once been curled can never be restored to usefulness. Then the best thing to do is to keep the trees cultivated and in a vigorous condition so that they will throw out a second set of leaves with which to mature the fruit of the season.

A GOOD NATIVE GRASS.

Considerable inquiry has been received at the experiment station at Stillwater this spring in regard to a native grass that seems to be gaining a foothold in the territory. There are two forms of it. One is called the Texas blue-grass and the other the Smooth Texas blue-grass. They are much like the Kentucky blue-grass and are very closely related botanically. They are a little coarser than the Kentucky but in form of head closely resemble it. The Texas blue-grass has a growth like short wool in the head among the grains while the Smooth Texas blue-grass does not have it. The taste is much like that of Kentucky blue-grass. It seems to be relished by all sorts of grass-eating animals. It appears first in a bunch or two here and there but soon spreads so as to cover considerable area. It may be propagated either by seeds or parts of the plant, but seems to be spreading without special attention. It promises to be one of the best pasture grasses for Oklahoma.

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EXAMINATION OF MINERAL SPECIMENS.

The department of Chemistry is frequently asked to make assays for gold and silver. This is a time-consuming operation, and not a proper line of station work, and yet many such assays have been made. In the future, those who wish assays should send their samples to an assayer, have the work done, and pay for it. The Chemist of the station will examine qualitatively the specimens sent in after the publication of this report, determine their mineralogical names and so report them. No assays for gold or silver will be made.

Since the establishment of the Experiment Station, requests have been received for more than five hundred assays. Below will be found the result of a few of these determinations.

DESCRIPTION.	RESULT.
Gold ore from Guthrie	No gold or silver.
Valuable Find from Perkins	Pyrite and Galena.
Ore from Orlando	Gypsum.
Ore from Guthrie	Galena in Conglomerate.
Gold ore from Norman	No gold or silver.
Rock from Guthrie	Lime, 8.25 p. c.; Alumina 12.87 p. c.; Iron Oxid, 1.84 p. c.; Magnesia 0.38 p. c.; sand, 76.72 p. c.
Three samples from Okeene	1. Sandstone with traces of Galena. 2. Sphalerite. 3. Low grade Limestone.
Two Gold Ores from Oklahoma City	1. 1-20 oz. of gold per ton. 2. No gold or silver.
Three Ores from Orlando	Two contained a trace of copper. One a trace of copper and lead.
Twenty-six samples of ore	Nothing of value.
Ore from Downs	Sandstone.
Ore from McLoud	Pyrite and Sphalerite.

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Ore from Yates ..... Traces of Pyrite.

Two ores from Eden ..... 1. Barite with sand, limestone and Pyrite.
2. Pebbles of quartz showing flakes of mica.

"Madstone" ..... ? ?

Two gold ores ..... 1. Pyrite.
2. Pyrite on quartz.

Ore from Cleveland ..... Limestone and pyrite.

Ore from Choctaw ..... Sphalerite.

Ore from Ingalls ..... Clay.

Rock from Edmond ..... Ferruginous sandstone.

Seventeen samples from Eubank ..... Flint and strontianite. No gold or silver.

Fire clay from Ingalls ..... Low grade soapstone.

In most of these cases where Pyrite, Galena, or Sphalerite were found, they were present in small grains imbedded in useless gangue.

Five samples from Clayton ..... Clay and sandstone set with small pieces of gypsum and calcite.

Three samples from Stillwater ..... 1. Sand and chalcocite.
2. Sand and Malachite.
3. Sand and calcite.

One sample from Law ..... Pyrite and Galenite.

Ten samples from Woodward ..... 1. In. sol. matter, 60.99.
Iron oxid and alumina 1.74.
Lime, 16.20.
Magnesia, 4.50.
2. Sandstone and mica.
3rd, 4th, 5th, 6th, 7th, 8th, 9th, contained about the same elements as number one.
10. Silica 60.25.
Lime 5.11.
Magnesia, 6.78.
Iron oxid, 4.15.
Alumina 17.28.
Sulfur Trioxid 3.69.
Water and organic 2.74.

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One sample from Avoca ..... Sand and magnetite.

One sample from Ponca City ..... Limestone.

Ore from Marshall ..... Assayed for gold and silver, neither found.

Two samples from Kingfisher ..... 1. Massive gypsum.
2. Aluminum oxid.

Ore from Oklahoma City ..... Assayed for gold and silver.
Contained silver 1.25 oz. per ton.
Gold trace.
Of no value.

Nine samples from Shawnee (the first and second were hand made) .....
1. Contained 488.0 oz. gold per ton; 220.0 oz. silver per ton.
2. Con. 47.5 oz. gold per ton.
4.0 oz. silver per ton.
3. Shale.
4. Shale and organic matter.
5. Contained 31.1 per cent iron.
6. Coal. Moisture 5.9.
Vol. Matter 37.6.
Fixed Carbon 49.5.
Ash 3.6.
S. 3.4.
7. Ore containing .32 p. c. copper.
8. Limestone and Calcite.
9. Consisted of Conglomerate, dirt, Calcite and pyrite.
No silver or gold as the sender believed it to contain.

One sample from Tonkawa ..... Black Magnetic sand.

Seven samples from Orlando .....
1. Ferruginous sandstone.
2. Sand cemented by Calcium Carbonate.
3. Sand cemented by Clay.
4. Iron stone.
5. Fair sample of wad.

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	6. Nodular masses consisting of quartz, limestone, and small pieces of galena.
	7. Marcasite with structure of wood, with traces of copper.
Thirteen samples from Oxley	1. Limestone with trace of Malachite.
	2. Granite.
	3. Same as No. 2.
	4. Mixture of Sphalerite with crushed rock. Bore evidence of being home made.
	5. Limestone with small amount of copper.
	8-13 Rocks.
Ore from Arlington	Blue clay and soapstone.
Four samples from Lexington	1. No gold. 1 oz. of silver per ton. Trace of copper.
	2. No gold. No silver. No copper.
	3. Red shale, no valuable metals.
	4. White sand rock, contained a trace of silver.
Two samples from Guthrie	1. Impure limestone, with large amount of insoluble matter.
	2. Yellow oxid of iron with considerable insoluble gelatinous residue.
Rock from Chandler	Calcium carbonate with small amount of sand.
Ore from Range	Assayed, but contained nothing of value.
Rock from Clifton	Lime and sandstone.
Powdered rock from Langston	Consisting of iron oxid and sand.
Ore from Stroud	Lime rocks with iron and organic matter, looking very much like zinc sulfid.

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Ore from Cleveland .....Limestone and pyrite.

Three samples from Plymouth, ...1. Ferruginous quartz and sand rock.
2. Sample of impure wad.
3. Finely powdered manganese dioxid.

Of course, the station cannot vouch for the authenticity of any of these samples. This report is made to show, in a measure, the number of calls made for analyses which are entirely outside of the province of station work. Cultivation of the soil for crop production has proven profitable in Oklahoma; digging for "minerals," up to the present time has not.

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MISCELLANEOUS WATER ANALYSES.

During the year, forty-nine samples of water have been examined and in some cases, analyzed. Attention is again called to the fact that the station cannot undertake analyses of this nature unless the samples are taken in accordance with instructions which will be sent upon application. A sample of water carelessly drawn or concerning the source of which we have no information is valueless and will not be analyzed.

Three bulletins, numbers 7, 29, and 38, have been issued reporting results of water analyses. Copies of these will be sent to those who wish them. The following analyses have not been published, and in many cases, are incomplete but sufficient for the question involved.

No. 1337—Well on S. E. 1-4 sec. 29, twp. 20, r. 3 E. 37 ft. deep.
Total solids,—77.6 parts per 100,000.

No. 1539—Cold water creek near Hardesty, Oklahoma.
Total solids—76.8 parts per 100,000.

No. 1543—Well on N. W. 1-4 sec. 15, twp. 12, r. 6 W. 12 ft. to water, 20 ft. of water.

Total solids—54.6 parts per 100,000.
Calcium carbonate—33.9 parts per 100,000.
Sodium carbonate—2.2 parts per 100,000.
Sodium chlorid—10.0 parts per 100,000.

No. 1584—Artesian well, Fairland, I. T., 6 to 9 in. in diameter, 1152 ft. deep.
Total solids—25.8 parts per 100,000.
Calcium carbonate—8.9 parts per 100,000.
Magnesium carbonate—3.0 parts per 100,000.
Magnesium chlorid—4.0 parts per 100,000.
Sodium chlorid—6.8 parts per 100,000.
Sodium carbonate—2.7 parts per 100,000.
Undetermined—0.4 parts per 100,000.
Organic matter—0.044 parts per 100,000.

No. 1766—Wolf creek near Omer, Okla.
Total solids—151.0 parts per 100,000.

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No. 1876—Well on S. E. 1-4 sec. 12, twp. 10, r. 1 w. Contained 30 ft. of water.

Total solids—38.0 parts per 100,000.

No. 1927—Well on S. E. 1-4 sec. 6, twp. 17, r. 7 w. Water comes to surface, on west side of creek.

Total solids—72.0 parts per 100,000.

No. 1928—Same location as No. 1927 except on east side of creek.

Total solids—91.4 parts per 100,000.

No. 1931—Well 69 ft. deep with 20 ft. of water, 3½ north, 1 1-4 west of Ingalls.

Total solids—206.4 parts per 100,000.

No. 1982—New well at Otoe sub-agency.

Total solids—51.6 parts per 100,000.

No. 1983—Old well at Otoe sub-agency.

Total solids—47.6 parts per 100,000.

No. 1980—City well at Guthrie, Okla. 1 ft. in diameter and 200 ft. deep. (See analyses below.)

No. 1981—City well at Guthrie, Okla., 1 ft. in diameter, 500 ft. deep with 200 ft. of water. (See analyses below.)

	No. 1980	1981.
Total solids,	2066.8	1777.6 parts per 100,000.
Sodium carbonate,	6.4	6.4 parts per 100,000.
Calcium sulfate,	481.6	331.7 parts per 100,000.
Calcium carbonate,		10.0 parts per 100,000.
Magnesium sulfate,	77.8	4.2 parts per 100,000.
Magnesium chlorid,	61.2	75.9 parts per 100,000.
Sodium chlorid,	1406.5	1323.2 parts per 100,000.
Undetermined,	33.3	26.2 parts per 100,000.

No. 2073—Spring on lot 5 sec. 13 twp 10 n r 5 w.

No. 2074—Spring 1-4 mile from No. 2073.

	No. 2073	No. 2074.
Total solids	42.8	47.2 parts per 100,000.
Calcium carbonate,	21.4	21.8 parts per 100,000.
Magnesium carbonate,	7.3	10.9 parts per 100,000.
Magnesium sulfate,	0.8	0.8 parts per 100,000.
Magnesium chlorid,	2.4	2.4 parts per 100,000.
Sodium carbonate,	3.0	3.0 parts per 100,000.
Undetermined,	7.9	8.3 parts per 100,000.

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No. 2080—Artesian well at Vinita, I. T. "passing through 5 ft. soil and clay, 107 ft. slate, 400 ft. flint, 23 of "limestone" (first flow of water) 90 ft. "limestone" (second flow of water) and 175 ft. "limestone, very hard." Subsequent correspondence indicated that the last 175 ft. was granite instead of limestone. Flow of well estimated at 100,000 gallons in 24 hours.

Total solids—105.0 parts per 100,000.
Calcium carbonate—5.7 parts per 100,000.
Calcium sulfate—1.4. parts per 100,000.
Calcium chlorid—0.4 parts per 100,000.
Magnesium chlorid—4.5 parts per 100,000.
Sodium chlorid—59.8 parts per 100,000.
Potassium chlorid—1.9 parts per 100,000.
Sodium carbonate—26.5 parts per 100,000.
Undetermined—4.8 parts per 100,000 .

No. 2090—Well on S. W. 1-4 sec. 12, twp. 9 r. 19 w., 7 ft. to water. Said to have corrosive action on boiler tubes.

Total solids—36.1 parts per 100,000.
Calcium carbonate—18.7 parts per 100,000.
Magnesium carbonate—4.0 parts per 100,000.
Magnesium sulfate—3.3 parts per 100,000.
Magnesium chlorid—2.4 parts per 100,000.
Sodium carbonate—5.3 parts per 100,000.
Undetermined—2.4 parts per 100,000.

No. 2108—Second artesian well at Vinita, I. T., "Formations passed through were clay and slate, 112 ft.; flint, 400 ft.; limestone, 38. ft.; granite, 125 ft. The first flow of water was found at a depth of 550 ft., the second flow at a depth of 640 ft."

Total solids—108.8 parts per 100,000.
Calcium carbonate—3.9 parts per 100,000.
Calcium sulfate—0.5 parts per 100,000.
Magnesium sulfate—0.5 parts per 100,000.
Magnesium chlorid—4.0 parts per 100,000.
Sodium chlorid—64.4 parts per 100,000.
Sodium carbonate—29.2 parts per 100,000.
Undetermined—6.3 parts per 100,000.

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WINES AND WINE MAKING.

A. G. Ford.

Science has given to the wine making industry the possibility of many definite results. To follow out the operation scientifically and according to the most recent methods would call for the expenditure of some money and considerable time. It would be wasting both time and money to attempt to follow out one of these systematized methods unless the wine maker was properly located and then desired to follow the industry on an extensive commercial scale. All the Oklahoma farmer desires are such suggestions in addition to the practical knowledge already possessed, as will enable him to prepare his fixtures and follow out a method, using only what material he may have at his disposal.

However careful the practical farmer or the experienced wine maker may be, they will both have in their cellars spoiled wines to be disposed of. By a study of the most recent methods and a careful observance of the facts brought to light by science, a sufficient amount may be gleaned from them to be of considerable value to the farmer.

FERMENTATION, THE YEAST.

The air, at the proper temperature and humidity, is filled with myriads of little plants called yeasts. It would require five hundred billions of these little vegetable cells to occupy the space of one cubic inch. These little plants that may be called fungi, pass into an active state and multiply when in contact with a saccharine solution. The bread yeast, which is similar to the wine yeast, requires, however, a starchy substance for its development. The beer yeast develops in the same way as the wine yeast but does not produce as much alcohol. There are also numerous kinds of wine yeasts, all producing varying quantities of alcohol from the same kind of grape juice, and some producing or causing to be produced very different flavors or aromas.

The yeasts that float about in the air seem to exist in a kind of dormant condition, and do not immediately attack the sugar solution on coming in contact with it. If then an active yeast be used to start the ferment, it will possess very many advantages over the one that lives in the air.

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Besides the three yeasts mentioned above, there are many other kinds that live in the air; and unfortunately many of them vastly outnumber the true wine yeast. Many of them develop and grow in the grape juice right along with the wine yeast, setting up conditions that later spoil the wine. Their growth may be very much retarded or practically prevented by keeping the temperature of the solution at a point which is most beneficial to the wine yeast and yet detrimental to its enemies.

The juice which is expressed from the grape contains, on an average, about twenty per cent of grape sugar. This grape sugar constitutes the saccharine matter upon which the wine yeasts become active and greatly increase in number. In the process of this germination, the grape sugar in the grape juice is converted into alcohol. Authorities differ as to how this conversion is brought about, some saying that the yeast in its process of growth breaks up the sugar compound into several parts, one part forming into alcohol, another being wasted, while another goes as a food constituent to the fungus. Other authorities believe that the yeast does not perform such a function, but that it is brought about through chemical changes, initiated by some substances produced by the growth of the fungus.

PERIODS OF FERMENTATION.

The fermentation that takes place in wine production is generally divided into three periods, the first occupying from three to eight days; the second lasting to the following spring, and the third from the close of the second on for any number of years until the wine is said to be "bottle ripe."

The first period is characterized by a rise in temperature, frothing, and, at the close, a partial settling and clearing up of the wine. In this period, the sugar is changed into alcohol.

The second period may be characterized by a further clearing up of the wine, the development of some aroma, and the assumption of a distinctly wine taste and odor. Some indications as to the success of the operation can generally be detected in this period.

In the third period, the characters that were taken on by the wine in the preceding periods are matured.

PRODUCTS OF FERMENTATION.

If all of the sugar in the grapes were converted into alcohol, the weight of the alcohol in the wine would be about one-half the

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weight of the original sugar. Besides this alcohol, there is produced a gas—oxide of carbon, acetic acid, glycerine, aldehydes, and numerous ethers that give the wine its aroma.

Other products that arise during fermentation and the development of the wine are "lees" and argol. The former collects on the bottom of the vessel, and consists of about forty per cent. organic matter, coming from the dead yeast cells. The balance consists of mineral salts. The argol collects on the sides of the vessel and is pink in color. This is crude cream of tartar, and from fifty to sixty per cent. of tartaric acid may be extracted from the deposit. As the grape juice or "must" ferments, the per cent. of alcohol increases; and the argol being not so soluble in this solution, as in the must, begins to separate, and collects on the sides of the vessel.

The increasing per cent. of alcohol soon renders the solution unfit for the life of the yeast, and when the alcohol has increased to fifteen per cent., the yeast cells are all dead and fermentation stops. The fermentation may stop long before the per cent. of alcohol reaches this figure, depending on the kind of yeast that has done the fermenting, its vigor, and the temperature of the fermenting solution.

THE PROCESS OF WINE MAKING, PREPARATION AND CONDITIONS.

Deep vessels are preferred to shallow ones, for the reason that the rapidity of fermentation can be controlled more easily. All vessels should be thoroughly cleaned, dried, and cooled before receiving the must. If a cellar be used for fermenting, it should be dry and perfectly free from any kind of mould or suspicious odors.

The grapes should be allowed to fully mature before picking. Green grapes contain very much acid, and very much acid is detrimental to the health of the yeast—they require a neutral solution to accomplish their best results. The picking should be done in very early morning in order to have the grapes as cool as possible when the crushing and fermenting begins. Only ripe and healthy grapes should be used, especially avoiding any soured fruit as this would introduce the acetic ferment, which in all probability would prove fatal to the wine.

If possible, a small vat of must should be started to fermenting a day of two before the large pickings are brought on, and when this small vat is at its highest point of fermenting, some of the yeast foam from it should be taken to start the new vats. This

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gives a fairly pure wine yeast, and one that is in its active state, and one that will begin work on the new vats immediately.

TEMPERATURE.

Authorities say that ninety per cent. of the failures to produce good wine are due to an improper temperature during the first period of fermentation. The most favorable temperature lies between 75 and 80 degrees Fahrenheit; and never should the temperature vary more than ten degrees above or below this. It would be much better if the variation were but five degrees above or below.

The heat generated by the action of the ferment will raise the temperature of the solution thirty degrees, if no cooling device is employed. Starting with a temperature of 75 degrees, would ensure a temperature of 105 degrees, sometime during the process, if the vats were placed in a hot room to remain throughout the fermentation period. When the temperature passed to 95 degrees or 100 degrees, the action of the wine yeast would diminish, while that of its enemies would increase. Here, perhaps the true wine yeast would die or else refuse to go on with the process of changing sugar into alcohol, while, at the same time, some other yeast would be excreting a product that was destined to destroy the wine. If the temperature should fall below 65 degrees, the wine yeast would again become dormant and refuse to do its task, while at the same time, another yeast would take up the work, but would produce a far less amount of alcohol from the same quantity of sugar. Of the two evils—high or low temperatures—the high seems to be the most formidable, yet it is the most difficult to prevent.

If a cellar is convenient, it should be used, as the temperature in summer is not so high as the interior of a house. If there be no cellar or if the temperature goes too high with the use of it, the proper temperature may be maintained by setting the fermenting vessel into a large vessel of cool water. The practice of keeping wet woolen blankets around the vessel and placing it where the wind may have free access to it is often followed. Numerous other schemes as well as machines have been invented to cool fermenting wines, but as they all entail some cost and labor, they will not be discussed here. If some device is not employed to reduce the temperature, when fermentation is carried on in hot weather, the resulting wine will generally spoil sooner or later or else will be of a poor quality.

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TREATMENT OF WINES.

Both water and sugar are very often added to the musts before fermentation begins. Water should never be added if the best wine attainable is desired. If a sweet wine is desired, a little sugar may be added. If the grapes are sweet, use very little, if they be sour, more may be used. It would seem best, however, to use only sweet grapes for sweet wines, and then add to the juice a small quantity of sugar.

If the average grape contains about 20 per cent of grape sugar, and if all this is converted into alcohol, the wine would contain about 10 per cent of alcohol. This is about the average per cent for a wine. When much sugar is added, the percent of alcohol averages about 12 per cent, or perhaps a little less; and this is about as much alcohol as the wine yeast in Oklahoma will ferment.

Cane sugar, when fermented, will give 54 per cent of alcohol. Now, in order to raise the per cent of alcohol in a wine from 10 to 12 per cent—its maximum, there would have to be added one-third of a pound of cane sugar to the gallon. Should sweetness now be desired, add sugar to suit the taste, remembering that the wine is already sweetened by about one or two per cent. of glycerine.

The above calculations are only approximately correct and are founded on the assumption that all the sugar would be fermented. It will serve, however, as a guide when sugar additions are practiced.

Alcohol is very often added to wines, and the process is called fortifying. Besides increasing the intoxicating power, it renders the wine a much better keeper. Examples of such wines are Port, Sherry and Maderia, containing, at times, as much as 20 per cent alcohol. This addition should be made just at the close of the first period of fermenting; adding it sooner would kill the yeast, or adding it later might give the wine an alcoholic taste and odor.

Tannic acid is sometimes added. This gives the wine better keeping qualities, and, in fact, will cure some of the diseases of wine. It accomplishes its work by precipitating out of the wine some nitrogenous matter that furnishes food for the disease germs. This effect can, in a measure, be produced in red wines by allowing the fermentation to take place in the presence of the hulls. The hulls contain considerable tannin and the water and alcohol will extract it. Care should be taken to always keep the hulls

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below the surface of the fermenting liquid, as they will quickly sour in the air and thereby produce the acetic ferment.

"Pasteurizing" is a process of treating wines by which their keeping qualities are almost assured. It consists in heating the wine to 140 degrees Fahrenheit and then stoppering the cask so that no air can get in. This temperature kills all the germs usually contained in a wine, and by letting no new germs in, the wine is safe. This process is said not to injure the wine.

CARE OF WINE.

When the first fermenting period is over, the wine should be carefully racked off into bottles, jugs, kegs or barrels, and for a time, loosely stoppered. Care should be taken to leave all sediment of dead yeast and other matter behind. The wine should now be stored away in a cool, dry place,—preferably a cellar. If, upon shaking up the vessels later, there should be much cloudiness, they should be racked again. Repeat this operation as often as is found necessary. The wine should, by all means, be racked off into new casks by the following spring. The casks should be watched after at all times in order that no stoppers are pushed out and the cask remain open. If any wine should spoil, it should be removed from the good wines, thus preventing the cellar from becoming inoculated with disease germs.

ANALYSES OF WINES.

The following analyses made by the writer while a senior student of the College in 1898, will give some idea of the composition of Oklahoma wines.

No.	Name of Sample.	Specific Gravity.	Alcoh'l by Volume.	Alcoh'l by Weight.	Solids.
1	Concord	.9928	8.52	6.85	1.25
2	Herman Jaeger	1.0297	10.20	8.20	11.57
3	Devereux	1.0263	12.10	9.75	11.79
4	Mixture of grapes	.9890	14.60	11 80	2.35
5	Mixture of grapes	.9855	13.57	10.97	6.22
6	Concord	.9939	8.95	7.19	1.73
7	Norton's Virginia	.9975	11.60	9.28	3.27
8	Herbemont	.9949	8.87	7.01	1.71
9	Catawba	.9925	10.35	8.33	1.78
10	Concord	1.0204	13.90	11.23	10.09
11	Concord	1.0332	13.65	11.02	14.43

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The first five came from the Experiment Station wine cellar. The next three came from a local wine-maker, one mile west of Stillwater. The next one—number nine—came from Oklahoma City; and the last two came from ten miles south of Stillwater.

It will be seen that these wines are quite variable in percentage of alcohol; and the solids are extremely variable—ranging from a per cent that is entirely too low to that which is absurdly high. The last two wines had considerable sugar added to them. It will be noticed in both that their specific gravities are high as well as their alcoholic and solid contents.

The grapes from which these two wines were made came from different localities, but were fermented in the same season, by the same person, and by the same process. These wines were fermented without exposure to the air.

The following analyses were made by the writer in January 1899 and in January 1900. They are wines taken from the same corresponding casks, one year having intervened between the sampling. The wines were all dark red in color.

Station number.	1899. Name of Sample.	No.	Specific gravity.	Alcohol by volume.	Alcohol by weight.	Total acids as tartaric.	Solids.
1409	Norton's Seedling....	1	1.0018	10.33	8.25	.58	3.29
1410	Norton's Seedling....	2	.9959	15.43	12.53	.72	3.92
1411	Norton's Seedling....	3	1.0078	17.30	13.92	.71	7.35
1412	Norton's Seedling....	4	1.0513	14.65	11.26	.67	17.90
1413	Norton's Seedling....	5	.9945	16.30	13.27	.64	3.98
1415	Norton's Seedling....	7	1.0707	13.80	10.41	.54	22.70

Same wines as analyzed one year later:

Station number.	1900. Name of Sample.	No.	Specific gravity.	Alcohol by volume.	Alcohol by weight.	Total acids as tartaric.	Solids.
2050	Norton's Seedling....	1	.9998	9.90	7.44	.89	3.27
2051	Norton's Seedling....	2	.9961	14.00	11.26	.92	3.95
2052	Norton's Seedling....	3	1.0075	16.00	12.74	.89	7.41
2053	Norton's Seedling....	4	1.0510	13.70	10.44	.86	18.02
2054	Norton's Seedling....	5	.9948	16.10	12.98	.81	4.05
2055	Norton's Seedling....	6	1.0248	16 40	12.84	.78	11.76
2056	Norton's Seedling....	7	1.0710	14.20	10 62	.63	23.29

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The analyses of 1899 show the wines to contain considerable alcohol, and as a whole are fairly uniform in amount. The acids are a little low, while the solids are all too high.

The analyses of 1900 show a slight decrease in percent of alcohol, except number seven, which has slightly increased. All the acids have increased, bringing the amount up to full strength. All solids have increased excepting number one which stands at about the same per cent during the entire year.

The cause for the decrease in alcohol is probably due to part of it passing into ethers and some going into acetic acid, which has raised the acid percent. This increase in solids is perhaps due to cane sugar passing into glucose, the resulting product being heavier than the cane sugar alone; also to the development of small amounts of glycerine during this and other changes.

Sample one had no sugar added to it at any time, and as a result it is lowest in alcohol and solids. Numbers two, three, and four had one, two, and three pounds per gallon respectively added to the mashed grapes. Numbers five, six, and seven had one, two, and three pounds respectively added to the must. Theoretically, there should be no difference—getting the sugar in before fermentation is quite sufficient.

All of these wines were racked on September 30th, October 10th, and November 30th, 1898, but since then no further treatment has been given them.

SUMMARY.

Every thing about the winery should be kept perfectly clean.

Only sound, ripe grapes should be used.

The temperature during fermentation should be kept between 75 degrees and 85 degrees Fahrenheit.

The wines should be racked until no further sediment is deposited.

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CORN, KAFIR CORN AND ALFALFA AS BEEF PRODUCERS.

F. C. Burtis.

The station has under way a series of steer feeding experiments to compare the feeding value of corn and Kafir corn fed with alfalfa hay and Kafir corn stover. These will extend over three to five years. The first year's test was closed April 3rd. after being under way one hundred and forty-seven days, and the steers were sold on the Kansas City market April 13. The following is a summary of the results and is given as a progress report, and final conclusions should not be drawn from it, but compared with future results.

The past winter's experiments included twenty head of steers, native to the region of Stillwater, Oklahoma. They were mostly grade shorthorns of only fair quality and came from the grass in ordinary condition. They were about thirty months old when put into the experiment, the last of October, and averaged 976 lbs. in weight.

The twenty head were divided into four lots of five steers each, and fed in open yards with sheds for shelter. The lots were numbered I, II, III, IV and fed as follows for one hundred and twelve days:

Lot I—Kafir meal and alfalfa hay.

Lot II—Corn meal and alfalfa hay.

Lot III—Kafir meal and Kafir stover.

Lot IV—Corn meal and Kafir stover.

The grain was weighed in twice a day and the roughage once, and any waste weighed back once a day, and the steers weighed once a week. The original plan was to finish the lots on the above respective feeds, but the supply of alfalfa ran out and it was not possible to procure more within one hundred miles of the station at that time; so the feeds were changed February 27th and the fattening finished on other feeds.

[NOTE.—Explanation of terms: *Kafir*, the crop in general; *Kafir corn*, thrashed grain; *Kafir heads*, portion bearing grain; *Kafir fodder*, whole plant above ground; *Kafir stover*, Kafir fodder minus the heads or grain; *Kafir meal*, ground Kafir corn.]

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The following table gives the result for the first period of 112 days:

Data for 112 Days.	Lot I—Fed Kafir meal and alfalfa.	Lot II—Fed corn meal and alfalfa.	Lot III—Fed Kafir meal and Kafir stover.	Lot IV—Fed corn meal and Kafir stover.
Gain per lot	1308	1426	1254	1124
Daily gain per steer	2.34	2.54	2.33	2.01
Grain eaten per pound of gain	7.35	7.	10.58	9.3
Gain produced per bu. of grain	7.62	8.	5.29	6.02
Roughage eaten per lot	6414	7210	5321	5786
Roughage fed with each bu. of grain—lbs.	56	54½	43	53½
Cost per pound of gain—cts.	5.24	4.92	5.56	5.18
Grain eaten per lot—lbs.	9617	9991	13270	10456

KAFIR CORN AND ALFALFA *VS.* KAFIR CORN AND KAFIR STOVER.

The Kafir corn alfalfa fed steers made 4.3 per cent more gain than Kafir stover fed steers, and ate 27.5 per cent less grain. The former's gain cost 5.8 per cent or .32 of a cent less per pound, and required 3.23 pounds less of grain for the production of each pound of gain. In other words, with the alfalfa each bushel of Kafir corn (56 lbs.) produced 7.62 pounds of beef, while without the alfalfa, a bushel produced only 5.29 pounds, a difference of 2.33 pounds of beef in favor of the combination with alfalfa where 56 pounds of alfalfa was fed with a bushel of Kafir corn.

CORN AND ALFALFA *VS.* CORN AND KAFIR STOVER.

The corn and alfalfa fed steers made 26.8 per cent greater gain than the corn and Kafir stover fed steers, and ate 4.44 per cent less grain, and the former's gain cost 5 per cent or .26 of a cent less per pound than the latter and required 2.3 pounds less grain to produce a pound of gain. Fed with alfalfa a bushel of corn produced eight pounds of beef, while without the alfalfa a bushel of corn produced only 6.02 pounds, a difference of 1.78 pounds of beef in favor of the combination with alfalfa where 54½ pounds of alfalfa were fed with each bushel of corn.

CORN *VS.* KAFIR CORN.

Comparing the corn and Kafir corn as beef producers; first in the case of Lots I and II where alfalfa was fed with each; the

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Kafir corn fed steers made 8.2 per cent less gain but ate 3.7 per cent less grain than the corn fed steers, but the former required five per cent or .35 of a pound more grain to produce a pound of gain.

Again with Lots III and IV where the alfalfa was not fed with the grain, the Kafir fed steers made 11.57 per cent more gain but ate 26.9 per cent more grain than the corn fed steers, and the Kafir steers required 10.58 pounds, and the corn steers 9.3 pounds of grain for each pound of gain, 13.76 per cent more of the Kafir corn than the corn.

Taking an average of the two comparisons it required 10 per cent more Kafir corn than corn to produce a pound of gain. In case of the Kafir corn, alfalfa saved 30.53 per cent of the grain, and in case of the corn 24.73 per cent an average saving of 27.8 per cent in the grain, and a saving of 5.4 per cent in the cost of the gain. This was when corn and Kafir meal were figured at $8.21 per ton, alfalfa hay at $6.00 per ton, Kafir stover at $3.00 per ton. The showing in the saving of the cost of gain would be larger as the price of corn advanced. In this instance it was twenty cents a bushel and cost of shelling and grinding. The alfalfa was of very poor quality and much better results would have been obtained from a good article. Besides it would be as good as a gold mine, to many a farm in Oklahoma, to figure alfalfa at $3.00 per ton on the farm. At that figure there would be quite an increased showing in favor of the alfalfa fed steer in the foregoing results.

To make the foregoing comparisons complete, the market values of the respective Lots at the end of the period would be necessary but as the steers were not in marketable condition as yet, this could not be done. The next best thing was done, an estimate was made. The Lots averaged in weight as follows:

Lot I—1238.
Lot II—1252.
Lot III—1224.
Lot IV—1210.

They had made a gain per steer of 262, 285, 251, 225 lbs. respectively. This would lack considerable of putting any of the Lots in marketable condition. Lot 2 was considered worth 10 to 15 cents more per cwt. than Lot 4, and about 5 cents per cwt. more than Lots 1 and 3 which were considered about equal. If this were true it would make a still better showing for the alfalfa corn fed steers over the corn Kafir stover fed steers than is shown in the previous data. It would not change the relation much of Lots 1 and

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3, or the relation of the corn to the Kafir corn. All the gains were too low for that time in a feeding period and better ones should be expected but this does not affect the comparisons.

For the second period of 35 days the feeds were changed to the following:

Lot I—Kafir meal, cotton seed and cotton seed meal.
Lot II—Corn meal, cotton seed and cotton seed meal.
Lot III—Same as Lot I.
Lot IV—Same as Lot II.

The proportion of the grains mixed was varied from time to time, but the proportion for the greater part of the time was Kafir or corn meal 18 parts, cotton seed 4 parts and cotton seed meal 2 parts. All the Lots received the same kind of roughage, millet hay and Kafir stover for three weeks, and millet and prairie hay for two weeks.

The following table gives the results for the second period of 35 days:

For 35 Days.	Lot I—Fed Kafir corn and mixture.	Lot II—Fed corn and mixture.	Lot III—Fed Kafir corn and mixture.	Lot IV—Fed corn and mixture.
Gain per lot	456	561	423	523
Daily gain per steer	2.6	3.2	2.45	2.99
Grain eaten per lb. of gain	8.02	6.54	8.73	7.01
Grain eaten per lot	3657	3667	3692	3667
Roughage fed per lot	2665	2665	2675	2675
Cost per lb. of gain—cts.	5.9	4.8	6.34	5.08

In this second period we have another comparison between corn and Kafir corn, but fed in connection with other grains. The results of the lots fed the same kinds of feed are quite close, so only the average will be compared.

The steers receiving Kafir corn meal with cotton seed and cotton seed meal gained 18.9 per cent less than the steers fed on corn meal and cotton seed and cotton seed meal. The amounts of grain eaten were practically the same for all the Lots, but it required 23.63 per cent more Kafir corn to produce a pound of gain than it did of the corn. Of the former, it required 8.37 lbs. of the latter 6.77 lbs. a difference of 1.6 lbs. in favor of the corn.

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The gains for all the lots were fair for this stage in a feeding period, and were even better than the gains during the first period. The cost per pound of gain was less in the case of Lots 2 and 4, and more in the case of Lots 1 and 3, than in the first period. For this period, corn and Kafir corn meal were figured at $10.00 per ton cotton seed $10.00, cotton seed meal $22.00, prairie hay $9.00, millit hay $6.00.

At the end of the second period, the steers were not fully finished, but as far as it was thought advisable with the advanced prices of grain and roughage, besides the steers were not of a type that would pay for a high finish. The steers were sold on the Kansas City market as they were fed. After a very close examination, a price of $5.00 per cwt. was put on Lot 2; $4.95 on Lot 1; $4.90 on Lot 3; and $4.85 on Lot 4. This represented very well their relative finish but the line was drawn very closely. The Kansas City weights were as follows:

Lot I—6410.
Lot II—6580.
Lot III—6340.
Lot IV—6370.

Compared with a weight made at the station before the steers were filled for shipping, it shows a shrinkage of 4.16, 4.3, 4.14, and 3.56 per cent respectively per lot; an average of 4.08 per cent for the 20 head, or a shrinkage in pounds per steer of 55.6, 59.2. 54.8, and 47 respectively or an average of 54.15 lbs. The steers were on the railroad 45 hours.

From the yard weights, Lot 1 dressed out 61.21 per cent; Lot 2, 61.71 per cent; Lot 3, 59.21 per cent; Lot 4, 60.69 per cent.

As to the profits made on the different lots, considering only the cost of the feed, the following table gives the results:

	Lot I.	Lot II.	Lot III.	Lot IV.
Cost of steers	$ 183 07	$ 181 20	$ 182 40	$ 184 80
Cost of feed	95 40	97 12	96 63	84 89
Total cost	$ 278 47	$ 278 32	$ 279 03	$ 269 69
Net sale	$ 322 80	$ 324 57	$ 306 17	$ 304 45
Net returns	$ 44 33	$ 46 25	$ 27 14	$ 34 76

This makes a total return of $152.48 over the cost of the steers and cost of feed. Four pigs ran after each bunch of steers but the

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results will not be given here, further than that the pigs used were quite young and were compelled to obtain their whole living from the droppings of the steers, and did very poorly.

There is a great argument in the foregoing results to induce the Oklahoma farmers to make greater efforts to grow alfalfa, as there is no doubt but that they must have it to make the most economical use of their feeds. Again at the average prices of cotton seed and cotton seed meal there will be a great saving in the cost of beef production if they are used in connection with corn and Kafir corn, especially when the farmer does not have alfalfa to feed; and more especially for the last 30 of 60 days of the fattening period.

The common feeds raised on the Oklahoma farms are deficient in protein and stock will not make the best gains on them without the addition of such feeds as alfalfa, cowpeas, cotton seed, cotton seed meal, linseed oil meal, soy beans, etc., that contain quite a large per cent of protein. Our experiments were planned to show the worth, and encourage a more extensive utilization of these feeds.

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GRAPE GROWING.

O. M. Morris.

Grape culture is fast becoming an important industry in Oklahoma. The vines make a good growth and bear well in most parts of the territory. According to the reports received at the experiment station, grape vines have proven to be the most uniformly hardy and productive of any of the fruit-bearing plants. There are many varieties that are well adapted to the soil and climate and have been grown here long enough to prove their worth.

Many new and promising varieties are being introduced and successfully grown in different parts of the territory, and it is to be hoped that this work will be continued until each locality has its own list of varieties. The reports published in bulletin No. 43 of this station placed Moore's Early, Concord, and Worden as the best three black grapes; Delaware and Catawba as the best red grapes, and Niagara, Moore's Diamond and Goethe as the best white or pink grapes. These are named in order of ripening under each color. There are many other grapes that are doing as well as these where planted, but are not so well distributed over the territory. The Concord is the most common grape in Oklahoma and in most localities is giving fair satisfaction. In many vineyards, however, it does not ripen its fruit evenly and is beginning to fall into disfavor on that account. The Herbemont, Jaeger, Cottage, and Brilliant are gaining favor and promise to become popular and profitable varieties. Other varieties of special promise are Rommel, Admirable, Early Ohio, Fern Munson, and Green Mountain.

PROPAGATION.

The vines can readily be grown from seed, but as they do not come true from seed, this method of propagation is seldom employed and only when it is purposed to rear new varieties. The vines are usually grown from cuttings. These are made in the late fall or winter from the mature wood of the last season's growth. The cuttings are made from 6 to 12 inches long. Some prefer a three joint cutting, but this is too long to be handled economically in long jointed vines. The cut at the base of each cutting should be made just below the node. The cuttings should be made as soon as the

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wood is cut from the vine and placed in moist earth or sawdust, out of the reach of frost, but in a cool place, until spring. The best practice is to bury the cuttings in well drained soil, covering them with about 6 inches of loose soil. They should be kept in their winter storage until the trees and vines have started well into growth. They are then taken up and placed in the nursery row. If the cuttings contain three buds, they are placed so that the top bud will be just above the ground; if the cuttings have but two buds they are placed with the top bud at or a little below the surface of the soil. The soil is well firmed around the cutting to keep it moist and to give the roots the best opportunity to grow. The cuttings are set from 10 to 18 inches apart in the row. The rows are about 4 feet apart. The soil should be rich and in a high state of cultivation. The age of the plants dates from the time the cuttings are set. They are commonly cultivated in the nursery until they are two years old when they are ready to be transplanted to the vineyard.

Good strong plants can be started from layers of the ripe wood. To start plants in this way the strongest canes should be selected and bent to the ground in the spring and covered with soil. The vines will send up a new plant at every bud and if strong plants are desired it is best to remove all but one bud on each layer. The plants should be separated from the parent vine in the fall and transplanted either to the nursery or to the vineyard.

Some varieties do not start well from cuttings. These may be grafted on cuttings or roots of other varieties and grown with entire success. It is usually best to leave the work of grafting to the nurserymen, but the following directions are given for the benefit of those who wish to make a trial at the work.

The whip or tongue graft is most commonly used in grafting cuttings or young vines. The stock should have two buds and the cion one or two buds depending on the length of the joints. The top end of the cuttings to be used as a stock is cut with a long sloping cut. The knife is then placed just above the upper edge of the pith and pressed down to split the end of the cutting and form a tongue. This split should not extend down further than the lower edge of the cut, across the end. The lower end of the cion should be cut and split in the same way. The two pieces are then pushed together so the tongues will hold them in place. The grafts are then wrapped with twine or some similar material to hold them together. In placing the cion and stock together the edge of the wood of the two pieces must meet at least on one side. After the graft-

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ing is done the grafts are treated the same as cuttings. When set in the nursery row the point of union should be placed below the surface of the soil. The operation of grafting on rooted cuttings or small plants is performed in the same way as just described. If the plants are taken up they should be handled the same as cuttings, only using more care to prevent their drying. If the plants are not taken up to be grafted, the soil should be removed below the first joint roots and the cion inserted below this point in the same way as on a cutting. However, if the stock is large, this will be impossible, and it will be necessary to split the stock and insert the cion in the side, or make a sloping cut in the side of the stock and insert the cion. The soil must be well packed around the graft to prevent its drying out.

PREPARATION OF THE LAND.

Vineyard lands should be in good cultivation before the plants are set. Bad weeds can be eradicated more easily while the land is planted to annual crops than after it is set in vineyard and every precaution should be taken to see that it is free from such. Coarse trash and litter should be removed, and not plowed under, so that the soil will be in a uniformly fine condition. It is best if the land be plowed early in the fall before the vines are set. The land should be cropped for several years before being set to a vineyard, in order that a good deep bed may be ready to receive the plants.

Much of the land in Oklahoma does not contain much vegetable matter, hence it bakes and crusts badly and does not retain moisture as well as it should. This defect should be corrected as much as possible before permanent planting is done. The best treatment for such land is to add large quantities of barnyard manure and turn under green crops. This work should be well done in order to give the vines a good start. After the vineyard is started the manuring will be rather a difficult process and usually shallow cultivation will be the only stimulus and aid to the fertility of the land.

SETTING THE PLANTS.

The plants are set in the fall or spring. The arrangement of the farmer's work is usually the controlling factor in this matter. There seems to be but little difference in results whether the plants are set in the fall or spring, if they are in good condition and well set. If the plants are received in the fall they will usually have better winter quarters if set in the vineyard immediately. The

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plants should be set the same depth in the vineyard that they were in the nursery row but better be set deeper than shallower. The roots are placed in their natural position and the soil well firmed around them. But little if any pruning will be needed. The roots should not be exposed to the air and become dry. Neglecting to keep the roots damp while transplanting causes nearly as much loss as all other causes combined.

The plants should be set in rows 8 or 9 feet apart in the row. The weak and medium growing varieties like Delaware and Moore's Early may be placed from 6 to 8 feet apart in the row while the stronger growing varieties like Herbemont and Lenoir should be placed from 10 to 14 feet apart in the row. The character of the soil and the method of pruning and trimming will also have some influence over the amount of space that each plant should occupy. If the plant is pruned very close each year, it will require but a small amount of space, but if a large amount of wood is left the space for each plant should be increased proportionally.

It will be of advantage to have the rows run north and south. This will place the trellis so that the trunk and base of the vine will receive the most protection from the sun. This will be of great advantage in spraying as a spray can be thrown across a strong current of air better than it can be thrown against it. The wind will not tear so many vines from the trellis if the rows run parallel to the prevailing winds, and in large vineyards the expense of keeping the vines on the trellis is of considerable importance.

CULTIVATION.

Clean cultivation should be followed from the first. A crop of early potatoes or something similar may be grown between the rows for the first year, or two, but this is not to be recommended lest the crop and not the vineyard receive the favor in cultivation. A regular system of cultivation should be determined upon when the vineyard is planted and should not be changed from year to year.

The surface soil is usually hard and compact in the spring, and it is a good practice to turn it with a small turning plow, running shallow so that it will not strike any of the large roots of the vines. This plowing gives an opportunity to turn under any trash or manure that may be upon the ground. This early stirring of the soil is beneficial in several ways. It increases the chemical activities in the soil; it increases the water holding capacity of the soil; and if carried on from the time the vineyard is set, will induce a

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deeper root growth. After the plowing, the land should be smoothed down with some lighter tool, as a harrow or cultivator.

The spring and summer cultivation should be shallow and frequent. No weeds or grass can grow in the vineyard without doing it harm. The vines alone should have all the moisture that the land contains. Cultivation may be stopped about the last of July or the first of August. Little growth should be made after this and the force of the vines should be spent in maturing the growth already made and the fruit. The soil should be in good condition the entire year. The greater part of the winter-killing of buds and vines is due to the dry and baked condition of the soil. This condition can not always be avoided but a little cultivation would greatly improve it in most cases.

When one system of cultivation has been adopted it should not be changed without some good cause. The principal object of the summer cultivation is to conserve moisture and destroy the weeds. Where shallow cultivation has been practiced entirely for a few seasons and the vines are giving fair returns, the deep plowing should not be attempted, as it will result in a very severe root pruning. But when it is determined to begin deep cultivation after shallow cultivation has been practiced, the start should be made in early spring, and the vines should be pruned very close. If the vines do not receive good care with such treatment it will result in more harm than good.

PRUNING.

Pruning and training are separate and distinct operations. Pruning is the cutting away or removal of some part of the plant for the purpose of benefitting the plant or its fruit. All the different modes of pruning are intended to bring about the same results and are based on the same principles. The vines can mature only a small portion of the fruit and wood that would be formed from all of the buds of one season's growth. This fact makes pruning a necessity. The fruit is borne on a few clusters near the base of the shoots of the season; these shoots start from buds on wood of the previous year's growth. These are the facts and conditions upon which all intelligent grape pruning rests. Training refers to the arrangement of the vines on the trellis. Some systems of training are better adapted to certain modes of pruning and can not be used with certain others. While there are only two principal methods of pruning, there are as many different systems of training as there are fancies among grape growers.

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In the following discussion the green leafy branches are called shoots. The ripened shoot is called a cane. An arm is a branch two or more years old and bears the canes and shoots, but does not change its form from year to year. An arm is designated as upright, horizontal, or sloping according to its position on the trellis. By some writers, an arm is called a cordon. A spur is a cane cut back from one to four buds. A renewal is a cane left for bearing wood but cut much longer than a spur. A stem or trunk is that portion of the old vine that reaches from the ground to the trellis.

EARLY PRUNING.

The vines should be cut back to two or three buds when set and to about the same number the following winter. If the vines are strong they may form the cane the second summer, but little more than the cane should be left. If the plants are weak they should be cut back about the same as after the first year's growth, and not be premitted to form the cane until the third summer. The pruning should be so done as to prevent heavy bearing for the first three or four years.

WHEN TO PRUNE.

The pruning may be done at any time during the winter. The vine ceases to grow when the leaves fall and is dormant until growth starts in the spring. Tender varieties do best when pruned in the fall, and laid down and covered with earth or straw to protect them during the cold weather. The strongest growing and most hardy varieties suffer less from winter drouth if pruned in the fall. The roots are dormant and take up but little moisture and when the winter is excessively dry the vines suffer for water and many of the buds are killed. If the most of the vines were removed in the fall much loss from winter-killing would be avoided. The pruning should not be done while the vines are frozen, as the canes will be broken and split in removing the extra wood. The work should be finished two or three weeks before growth starts in the spring in order to avoid bleeding. The cut should be made two or three inches from the last bud that is intended to grow, so that the cane drying at the end will not injure the bud. Ten or fifteen buds will usually be enough for the vine to support for its first crop. This number can be increased from year to year until the fourth crop, when the vines should be in full bearing and should support from twenty-five to thirty buds of bearing wood.

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The most convenient tool for cutting the vines is a pair of small hand shears. These may be purchased from any hardware store for 50 or 75 cents.

SUMMER PRUNING.

Most of the successful grape growers in Oklahoma are strongly opposed to summer pruning. The results of the work done in the Station vineyard seem to be very strong argument against it. It is a good practice however to clip off the ends of the most advanced shoots just before the plants bloom. This will check the growth of the most forward shoots, and give the tardy ones a start. The strongest shoots will be at the outer end of the cane or arm; and this condition must be overcome as much as possible. Cutting off the ends of the most advanced shoots is the best remedy and gives the shoots near the trunk a greater food supply. This pruning however should not be continued till summer, but just while growth is starting in the spring. Summer pruning prevents the fruit from maturing and if carried on for a number of years, will weaken the vines and in some cases kill them. The cutting back or removal of the shoots that start from the base and side of the trunk may be of positive benefit, but more than this is scarcely advisable.

MODES OF PRUNING.

The bearing top or head of the vine for the succeeding year is formed either by spurs or renewal. The spurs do not vary much in length but the renewals vary from six or eight buds to nearly the entire vine. With the spur method a large amount of old wood is carried in the spurs and arms. The spurs add only a small amount of wood each year, but this can not be removed without changing the method of pruning or the loss of a crop. Each year adds a spur to the spur of the preceding year, thus moving the bearing wood further from the trunk. The accumulation of large quantities of old wood is injurious to the growth and health of the vine. The old spurs form excellent hiding places for insects and diseases. This system of pruning is not so popular as it was a few years ago and is now rapidly passing into disfavor. The renewal usually starts near the head of the trunk but in some vineyards it is brought from the ground each year. This latter method requires a very low trellis and very strong growing vines. The vines that come from the ground are usually less productive than those that come from an arm or trunk. The position, number, and length of

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the renewals will depend on the system of training adopted. The strongest unbranched canes should be used where choice is left. The canes that are branched will not bear fruit as uniformly as the unbranched canes. This mode of pruning is very simple and easy to follow and can be readily adapted to any form of trellis or system of training. The amount of old wood is reduced to a minimum. The position of the bearing wood is largely under the control of the pruner. This method of pruning is gaining favor and is practiced by most of the successful vineyardists in the south and west.

TRELLISING AND THE TRELLIS.

The vines should be placed on the trellis as soon as large enough. If permitted to spread at will over the ground they prevent clean cultivation and encourage the spread of disease and insects, and are in such shape that these pests can not be fought. It is seldom necessary to place them on a permanent trellis the same year they are set. If the vines make a very strong growth they may be placed on a temporary trellis to keep them out of the way of the cultivator. A very good temporary trellis can be made by placing stakes about two feet higher in the row so there will be two or three vines between each two stakes and placing the wire on the top of these stakes.

Good sound posts should be used on the permanent trellis. Cedar, catalpa, black locust, osage orange or bois d'arc and post oak make good posts for trellis. If the posts are set they should be placed not less than two feet in the ground. If they are driven they should stand six or eight inches higher than is necessary for trellis, in order that they may be driven deeper and tightened from time to time. They should be placed so there will not be more than three vines to the post and two vines to the post will be better. Two or three large vines make a heavy load on the wires and a strong wire must be used to support such a load. A number 8 or 9 smooth galvanized wire will best serve the purpose. The iron wire may be used but it will not last as long nor stand the strain as well as the other wire. It is better to run the wire through the post than to trust to staples to hold the wire.

There are two forms of trellis in general use. The most common form is an upright trellis composed of two or three wires placed one above another. The wires are placed from fifteen to twenty inches apart with the lower wire twenty or twenty-four inches from

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the ground. This trellis is seldom more than five feet high and usually less. It is simple and easy to build and admits of many different forms of training. It is intended that this form of trellis will hold the vines so that the fruit will be exposed to the sun and air the same as if trained to a wall.

The canopy formed trellis is entirely different from the one just described. This trellis contains three wires all placed about the same distance from the ground. The three wires may be on a level with each other or the center one placed a little below the other two. The Munson trellis is the best example of this form. It consists of three wires so placed that the center wire is five feet and six inches from the ground, and about six inches below the other two, which are two feet apart. This trellis may be made by placing posts for each of the outside wires and attaching the center wire to a cross wire fastened to the posts. A simple form is to have the center wire fastened to the post and the two outside wires fastened to a cross bar on the same post. This will usually be cheaper and easier to maintain. Mr. Munson in the Farm and Ranch of October 21, 1899, states some of the advantages of the Munson trellis as follows:

"1. It accommodates the nature of the vine by furnishing a leafy, well ventilated canopy over fruit, vine and root, and allows the fruit to hang in free air, so no chafing occurs against the wires, or post or vine.

"2. It puts the work of pruning, tying, spraying, and harvesting in the most convenient position possible to save backache and do the work most expeditiously, with the least inconvenince, and permits passing from row to row through the vineyard, at any point by slightly stooping.

"3. It allows more readily of cultivation than any other continuous trellis.

"4. It permits free circulation of air and wind storms, thus keeping the ground better aereated in wet weather, helping to restrain disease, and avoiding blowing down of trellis, hence enabling it to last longer. The sheet of leafy vine, being held horizontally and edgewise to the winds, gives little resistance, and furnishes even exposure of the fruit to light, heat and air; hence secures even ripening.

"5. In cold climates, where vines have to be covered in winter, it permits the vines, as soon as pruned, to be readily laid down to be covered, and easily raised to be tied up in spring."

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The mode of pruning and training must conform to the trellis and but little choice is left in this matter with the Munson trellis.

TRAINING.

The fan system of training on the upright three wire trellis is the one most commonly used in small vineyards in the territory. The vine usually has but one trunk leading to the first wire. Hence the trunk branches and the bearing wood is spread upon the trellis in the form of a fan. The shoots run in all directions, some along the wires, some up over the top of the trellis and then down and other start down directly from the cane. The top wire is very heavily loaded and the two others bear but little weight. If the vine is a very strong grower the shoots will form a dense canopy from near the ground to the top so the fruit will get but little light and air and will be in the most favorable condition for insects and diseases to work upon it.

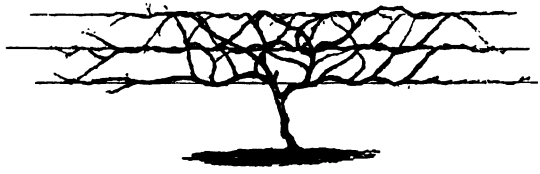

Figure 1.

Figure 1 shows an unpruned vine trained according to the fan system. The previous pruning has been done according to the renewal method. Figure 2 shows the same vine pruned and tied

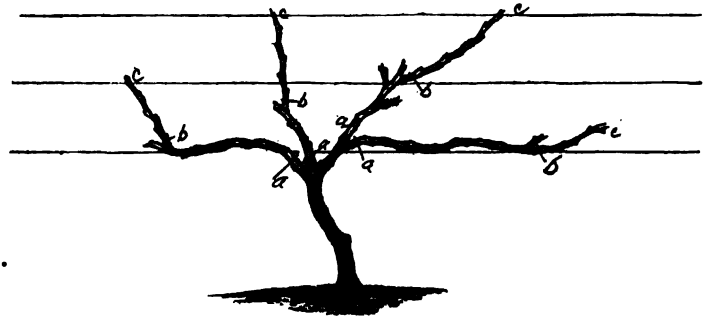

Figure 2.

according to the fan system of training as practiced in many vineyards. The canes from *a* to *b* bore the fruiting shoots of last season and the wood between *b* and *c* is to bear the fruiting shoots the

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coming season. The shoots nearest the tip of the cane have grown the strongest and have been kept for that reason. This system of training greatly encourages the growth of the outer shoots and unless care be taken in pruning the bearing wood will soon be removed a long distance from the trunk. It would have been better to have

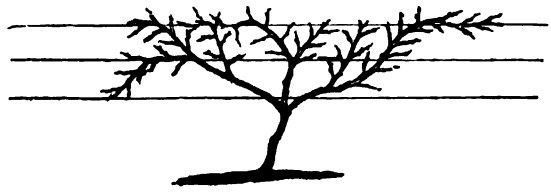

Figure 3.

left a good cane near *a* for the bearing wood. Figure 3 shows a common form of vine, spur pruned and trained according to the fan system. The open space near the top of the trunk has been caused by leaving too much wood, which has resulted in smothering out the lower vines. This vine would be better if one half or two thirds of the wood was removed.

The horizontal arm system of training is quite common and has many good points to recommend it. It allows free circulation of air among the vines and places the vines within easy reach of the spray. It makes pruning a very simple operation and does not confine the practice to any one method. However the expense of keeping the vines on the trellis is greater than with any other well defined system of training. An upright three or four wire trellis is always used. The arms or bearing canes are laid along the lower wire, one

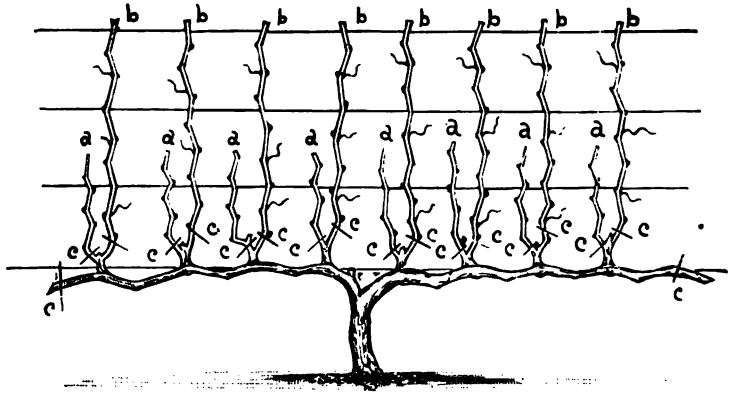

Figure 4.

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in each direction. The shoots are trained to run up and over the top wire and are then let run at will.

Figure 4 shows the form of a vine on which spur pruning has been practiced, but the vine has not been pruned since the last season's growth. A method of pruning that is sometimes practiced with this system of training is to let only one of the shoots that start from each spur bear fruit, and keep it pinched back to four or five joints. The other shoot is allowed to make a full growth and is used for the spur the following season. This practice requires a great amount of labor and could not be successfully followed in

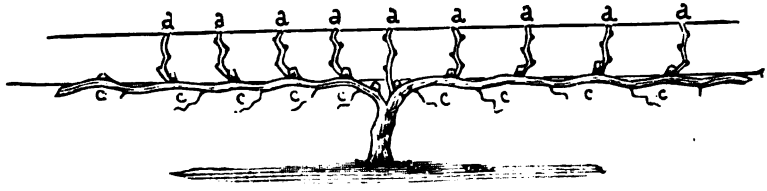

Figure 5.

an Oklahoma vineyard. Figure 5 shows the same vine pruned. Figure 6 shows a vine pruned according to the renewal method.

Figure 6.

The Kniffin system of training is not as widely known as its merits deserve. This system is practiced on a upright two or three wire trellis. The lower wire should be about two and one half feet from the ground and the top wire about three feet from the first one. The bearing wood is supported by a single trunk. The arms or bearing canes are placed in a horizontal position, one extending in each direction along the lower wire and one in each direction on the top wire. The young shoots are not trained to the trellis, but let hang from the cane. The vines require no attention to keep them in position after they are first placed on the trellis in the spring.

Figure 7 shows a vine before pruning. Figure 8 shows a vine pruned.

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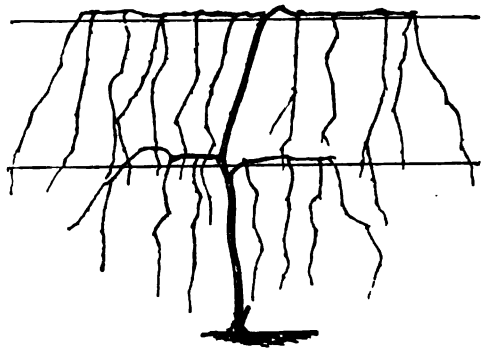

Figure 7.

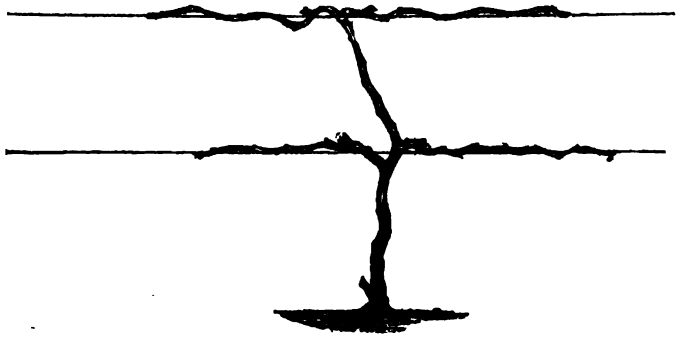

Figure 8.

The Munson trellis will hardly admit of more than the one system of training that is always practiced upon it. The bearing wood is supported by one, or sometimes two trunks that reach from the ground to the trellis. The renewal method of pruning is most always practiced. The strong unbranched canes starting from near the trunk are preferred for bearing wood. The canes are trained along the lower wire of the trellis and the shoots reach out to the wire on either side and wander over the trellis at will. About the only training necessary is to fasten the canes on the trellis in the spring. There will be an occasional shoot that does not start in the right direction to reach the outside wire, but these can be quickly placed on the outside wire and fastened. After the shoots become attached to the wire by the tendrils they can hardly be loosened by the wind.

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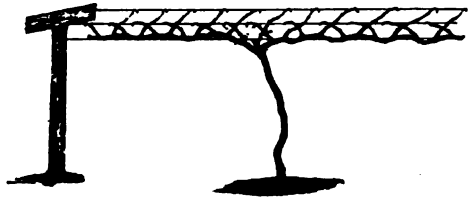

Figure 9.

Figure 9 shows the position of the young shoots on the trellis. Figure 10 shows the position of the renewal in early spring. Some

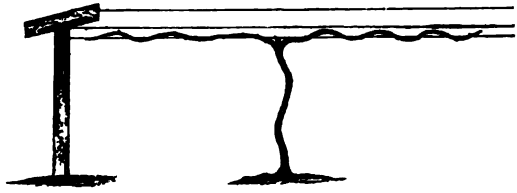

Figure 10.

prefer to leave four renewals, in which case there will be two extending in each direction from the trunk.

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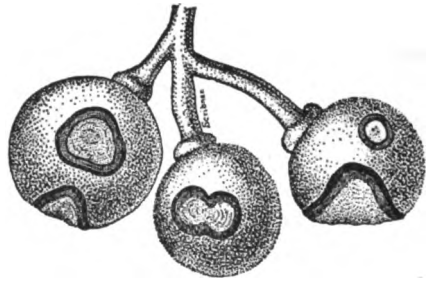
FUNGUS DISEASES OF GRAPES.

ANTHRACNOSE: SCAB: OR BIRD'S EYE ROT.

This disease is scattered over a good portion of the territory but has not caused much damage yet. It is one of the worst of plant diseases, as it attacks the fruit and all green portions of the plant and is very difficult to handle. Most of the methods of treatment prove unsatisfactory. The first appearance of this trouble should be vigorously met and all possible care taken to prevent its spread

This disease may appear at any time during the growing season. It commonly appears on the shoots soon after growth starts in the spring. Its presence on the shoots is first indicated by the darken-



Anthracnose: Scab: or Bird's Eye Rot.

ing and sinking of the bark in small oval or oblong spots extending lengthwise of the shoots. If the disease is abundant the shoots soon have a speckled appearance. These spots usually enlarge, the greater portion remaining black with a more or less distinct line of purple around the edge. After a time the center turns gray and forms a scab; this is the fruiting portion of the disease. Limbs badly affected are severely checked in growth or killed. The leaves are attacked and on the stem and vines show the same marks as on the shoots but on the blade of the leaf the spots turn brown. The stems of the clusters are also attacked, and where the spots girdle a stem the fruit below the girdle does not ripen but remains green and withers.

The disease usually appears on the berries when they are about half grown. The diseased portion is brown with the characteristic red or purple margin and round in outline. The discolored part is

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sunken and later turns to a lighter or gray color, which is caused by the fruiting portion of the fungus rupturing the skin and forming a scab. Some varieties are more susceptible to the disease than others. Among those most susceptible to its attacks are Goethe, Agawam, Vergennes and Diamond.

Treatment:—Treatment should begin early, before the buds open in the spring. The following solution is very good to apply as a wash before the growth starts in the spring.

Iron Sulfate (Copperas) 70 lbs.

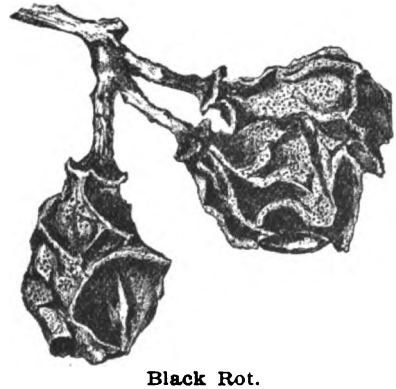
Sulfuric Acid 1 pint.

Warm water 16 gal.

The acid should be poured over the crystals of iron sulfate and then the water added. This if well applied will kill all of the spores that have lodged on the vines over winter. When this solution is used the vines turn black and any part of the vine that has not turned black within a day or two after the first application should be washed again. Bordeaux mixture is of value in holding the disease in check on the growing vines. The first application should be made soon after the buds have started in the spring and repeated about every two weeks till the fruit is about half grown. If it is necessary to spray after this time, the ammoniacal solution of copper carbonate should be used as it does not stain the fruit and is nearly as effective.

BLACK ROT; OR CHARBON.

The fruit when affected with this disease turns to a deep black color, hence the name. The fungus causing the disease attacks all parts of the plant. On the stem it causes black, oval, sunken spots which soon show a few dark pimples in the center. These pimples



Black Rot.

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are the fruiting portions of the disease and make this disease easy to distinguish from others. The affected portions of the leaves turn to a dark reddish brown color and are usually near the large veins but are not centered upon them as in the Anthracnose.

This disease seldom attacks the fruit till it is full grown. If the fruit is green the affected portion turns to a purplish brown, and this color soon spreads over the entire berry. Minute black pimples appear scattered over the surface and finally the berry withers, turns black and ultimately dries up, but, as a rule, remains firmly attached to the stem. These little pimples soon break through the skin and throw off the spores of the disease. It requires from two to three weeks after infection for the disease to complete its growth. The rapidity of growth and spread of the rot depends much on the condition of the weather. A warm moist atmosphere is very favorable to the development of the disease.

Treatment:—Much can be done to prevent the disease by training the vines on a good trellis to admit as much air and light to the fruit as possible. Although the disease does not appear till late in the season the preventive measures should be in operation before there are any signs of the attack. Spraying the vines with Bordeaux mixture or ammoniacal solution of copper carbonate are perhaps the best remedies known. The first application should be made about the time the vines have set three or four leaves. The second application should be made about two or three weeks after the first and the third about two weeks after the second. If the vineyard is badly infected the applications should be repeated about every two weeks till the fruit is ripe.

BROWN ROT; GRAY ROT; DOWNY MILDEW.

This fungus attacks the leaves, young wood, flowers and fruit. It is first distinguished on the leaves by greenish-yellow spots on the upper surface while the corresponding undersurface is covered with a white frost like growth. As the growth progresses the mildew disappeares, leaving the leaf dead and brown. The young wood and flowers present much the same appearance when attacked. This disease seems to develop in two forms on the fruit. One form is called brown rot the other gray rot. The brown rot does not make its appearance till the fruit is nearly grown. At this time small brown spots appear and soon cover the entire berry. The berry becomes very soft and falls from the stem at the slightest touch or jar. The skin remains unbroken till the berry falls. In

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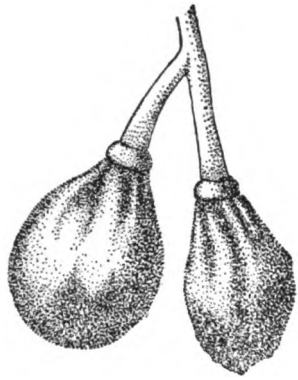

Brown Rot: Gray Rot: Downy Mildew.

the gray rot the berries are covered with the same kind of growth that appears on the leaves and stems.

Treatment:—This disease is most abundant on wet land and on vines that are on the ground or a very low trellis. If the vines are on a good trellis and so trained as to give the air a chance to pass freely through or under the vines but little trouble need be had. The Bordeaux mixture is a sure preventive for this disease. The first application should be made when the shoots are six or eight inches long and every two or three weeks thereafter.

RATTLES OR DROPPING.

What is known as Rattles, or Dropping of the Grape has caused considerable loss in some vineyards. The trouble is not due to any definite disease or insect but to the combined effect of drouth, disease, and insects, in which drouth is the most prominent factor. Preventive measures should be directed toward improving the health and vigor of the vines. It will usually be beneficial to fertilize the land and improve the method of cultivation.

(Acknowledgement is due the Mo. Exp. Sta. and Wm. Stahl, Quincy, Ills. for the loan of Cuts.)

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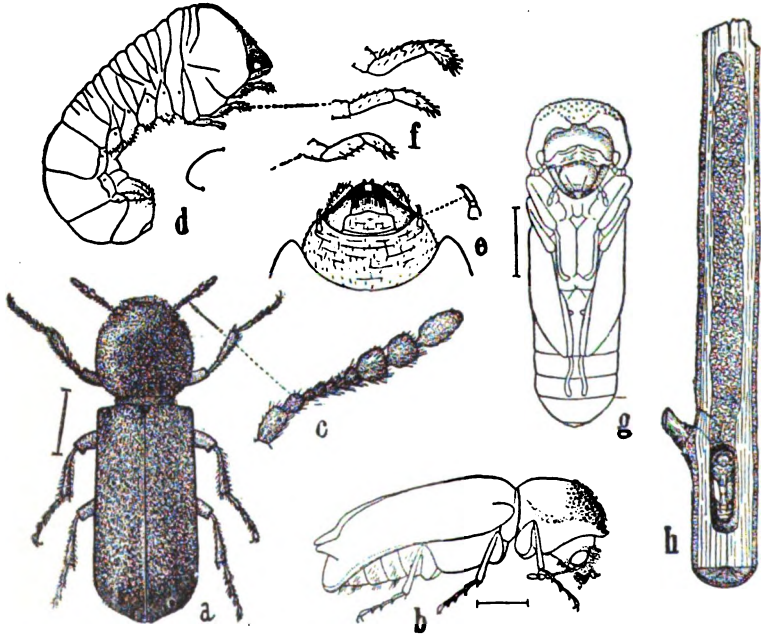
INSECTS AFFECTING THE GRAPE.

E. E. Bogue.

STEM BORER.

The damage caused by this insect—unlike that produced by some other borers—is done, not in the larval stage of the insct, but in the perfect stage, by the beetle itself. It works on the apple, pear, and cherry. It attacks the twig just above a bud and



The apple twig borer, "a," beetle as seen from above; "b," same in outline as seen from the side, showing projections on wing covers; "d," larva; "g," pupa; "c," antenna; "e," head of larva; "h," pupa in burrow; all but "h" much enlarged.

bores a cylindrical hole for several inches in the center of the twig causing it to wither and die. The early stages of this insect are not well known.

Remedy.—The injured twigs should be cut out and burned. No sure preventative is known.

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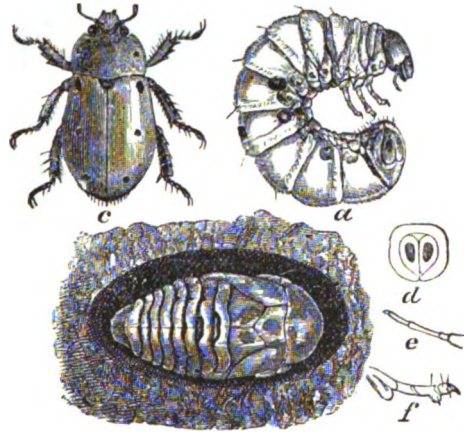
GRAY SKELETONIZER.

This beetle much resembles the Brown-backed skeletonizer in the character of its work but is less than a quarter of an inch long and one-eighth of an inch broad. It is dark-gray in color and when disturbed it falls to the ground and lies stupid where, on account of its color, it is hard to see.

Remedies.—It succumbs to poisons, but if poultry can be induced to feed upon it there need be but little trouble in getting rid of the beetle.

SPOTTED VINE-CHAFER.

This is a large beetle about one inch long and half as broad and rather thick. The wing-covers are tan yellow or reddish brown, and each has a black spot at each end and one in the middle of the margin, and there is also a black spot on each side of the thorax.



The spotted vine chafer, "a," larva; "b," pupa; c," mature beetle.

The under side of the body is a deep bronze-green. The legs of some individuals are the color of the wing-covers and of some others the color of the under side of the body. The larva feeds on decaying roots and stumps. It is not usually a troublesome insect, but some complaint has been heard of its eating the foliage of the grape.

Remedy.—On account of its large size, hand picking can be recommended. Spraying with poisons is also effective.

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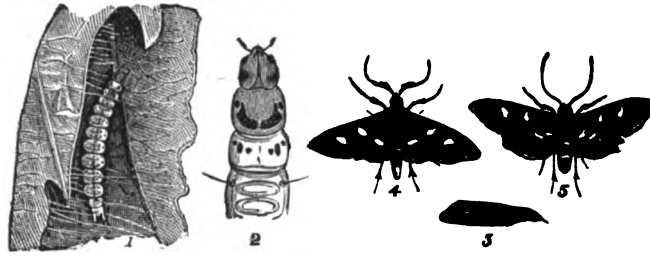
BROWN-BACKED SKELETONIZER.

This beetle is about five-sixteenth inches long by half as broad, varying in color from reddish brown to black. It works in spots in the vineyard eating out the green pulp of the leaves and leaving only the frame work or skeleton.

Remedies.—It may be destroyed by poisoning the foliage, spraying with Paris Green or London purple but it would probably be more satisfactory to induce poultry to feed on the beetle.

THE GRAPE-VINE LEAF FOLDER.

The work of this insect is known by its beginning on a small portion of the leaf of the grape, rolling the upper surfaces together and fastening them with silk. It feeds on the inside of the roll



The grape vine leaf folder. "1," larva, natural size; "2," front part of body, enlarged; "3" pupa, natural size; "4" male moth, natural size; "5," female moth, natural size.

and is thus out of the reach of ordinary insecticides. The full grown larva is about three fourths of an inch long. It changes to the pupa stage within the folded leaf, from which the moth emerges. The moth is about one inch broad when the wings are expanded. The wings are nearly black, with a few white spots and a faint white margin. There are two broods each season. The larvæ of the first brood appear in May or June in Oklahoma and the last one in August. The last brood passes the winter in the rolled leaves.

Remedies.—The insect has a parasite that doubtless does a good deal toward keeping it in check. This may be preserved and the enemy destroyed by collecting the rolled leaves before the moths escape from them and enclosing them in any kind of a receptacle that may be covered with a piece of loosely woven cloth that will allow the small parasites to escape, but will hold the months. With a little care and observation this can be done very

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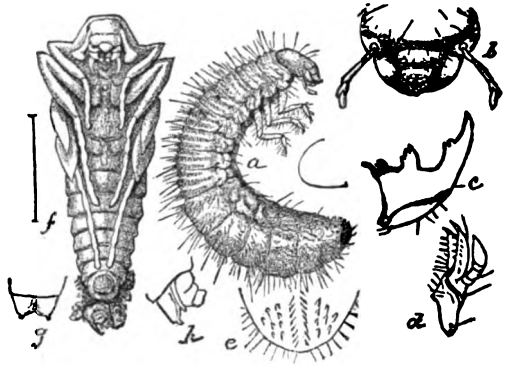
successfully. However, some recommend that no attention be given the parasite, but burn the leaves as soon as collected, which will destroy both parasites and moths. Spraying with Paris green as soon as the first insects appear is effective.

THE ROSE-CHAFER.

Most of the fruit growers of the territory are familiar with this beetle. Its habit of feeding on the flowers of the rose gave to the beetle its common name but the number of its food-plants



The rose chafer. "a," larva; "f," pupa; "b, e, g, h," structural details.

has been extended until it is now nearly omniverous. The flowers and leaves of the grape are relished by it but the leaves of the apple, pear, plum, cherry and leaves of many other plants are greedily eaten as well as young fruits.

The rose-chafer appears in Oklahoma in May and begins feeding voraciously and continues for from four to six weeks. During this time each female lays from one to two dozen eggs, singly, in the soil. Soon the eggs hatch and the larva begin feeding on the young grass rootlets if such are in reach. If not then the rootlets of other plants that are within reach. In autumn the larva have reached maturity, when they are yellowish in color with a brownish head. They decend to below the frost line; come near the surface in early spring, pupate, and soon emerge as perfect beetles to begin again the cycle of life. The insect prefers a light sandy sod soil for a breeding ground, so that if the grape growers guard their vineyards against this condition it will be a good preventive measure.

Remedies.—The beetle can not be easily poisoned. Hand picking twice a day, from the first appearance and as long as the

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beetles last, may be practicable. Coaxing poultry with wheat to where the insects are and then jarring them onto the ground may be a means of getting rid of the pest.

GRAPE-BERRY MOTH.

This insect passes the winter in the pupa stage concealed in the old leaves. The first brood in the spring feeds on the flowers, leaves and tendrils of the grape and the second one feeds in the young grapes. Infested berries show a round scar on one side. If a berry is cut open, the larva will be found within. When fully grown, it is a little over a fourth of an inch long and dark colored It comes out of the berry and passes the pupal stage in a piece of a leaf. The expanded moth is a little less than half an inch across. The front wings are mottled bluish and gray and the hind wings dull dark colored. The moth itself does no harm but lays the eggs which hatch into pupae.

Remedies. From the nature of the case, poisons are of no value for preventing injury from this insect. About the only way of preventing loss from them is to cover each bunch of grapes with a small paper sack, and this method is too expensive to be used extensively. In the fall, all poor fruit and old leaves should be destroyed to prevent the insect from passing the winter in them.

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INSECTICIDES AND FUNGICIDES.

BORDEAUX MIXTURE.

Copper sulfate (blue vitriol) 4 pounds,

Quicklime (not air slacked) 4 pounds.

Water, to make 50 gallons.

Dissolve the copper sulfate in about two gallons of hot water, contained in a wooden vessel, by stirring, or even better by suspending the sulfate contained in a cheese cloth sack, in a large bucketful of cold water. With the cold water and cheese cloth bag, a longer time is required. Pour the sulfate solution into the barrel or tank used for spraying, and fill one-third to one-half full of water. Slack the lime by addition of a small quantity of water, and when slacked cover freely with water and stir. Pour the milk of lime thus made into the copper sulfate, straining it through a brass wire strainer of about 30 meshes to the inch. Pour more water over the remaining lime, stir and pour into the other; repeat this operation until all the lime but stone lumps or sand is shaken up in the milk of lime. Now add water to make 50 gallons in the tank. After thorough agitation the mixture is ready to apply. The mixture must be made fresh before using, and any left over for a time, should be thrown out or fresh lime added.

AMMONIACAL SOLUTION OF COPPER CARBONATE.

Copper carbonate, 6 ounces.

Ammonia, about 3 pints.

Water, 50 gallons.

Dissolve the copper carbonate in the ammonia and add the water.

Caution. Use no more ammonia than is required to dissolve the copper carbonate. Ammonia is variable in strength, and the amount required must be tested in practice.

To make copper carbonate: Dissolve 10 pounds copper sulfate (blue vitriol) in 10 gallons of water, also 12 pounds carbonate of soda in same quantity of water. When cool mix the two solutions slowly, stirring well. Allow the mixture to stand twelve hours and settle, after which pour off the liquid. Add the same quantity

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of water as before, stir and allow to stand the same length of time. Repeat the operation again, after which drain and dry the blue powder, which is copper carbonate.

POTASSIUM SULFID.

Potassium Sulfid (liver of sulfer) 3 ounces.
Water, 10 gallons.

This solution is valuable for the gooseberry and other powdery mildews, for which it seems even more effectual than Bordeaux mixture, although its effects are less lasting. It does not discolor the fruit and is quite harmless.

PARIS GREEN.

Paris Green, 1 pound,
Water, 100-200 gallons.

For the destruction of insects that eat the foliage or fruit, Paris green is a valuable remedy. It can be used in water in the above proportions, the stronger mixture being used for potatoes, while for fruits it is seldom advisable to use more than 1 pound in 200 gallons of water, unless in connection with lime water or Bordeaux mixture. It is always advisable to first form a paste with a small amount of water before preparing it for spraying. For low plants Paris Green may be used in a powder form, either alone or with one hundred times its weight of plaster. London purple is sometimes used in place of Paris Green, but it is more apt to injure the foliage.

KEROSENE EMULSION.

Dissolve one-half pound hard soap in one gallon of water (preferably soft water) and while still hot, remove from the fire and add two gallons of kerosene. When soft soap is used, take equal quantities of soap and oil and omit the water before mixing. Stir the mixture violently by driving it through a force pump back into the vessel, until it becomes a creamy mass that will not separate. This requires usually from five to ten minutes. The emulsion is then ready to be diluted with water and applied. For the common scale insects and hard bodied insects, like the chinch bug, use 1 part emulsion to 8 or 10 parts water. For soft bodied insects (plant lice, etc.) use 1 pint emulsion to 15 or 20 parts water.

Kerosene emulsion kills by contact and therefore the application should be very thorough. It may be used against a great many different pests, but is especially valuable for destroying those with sucking mouth-parts, for they cannot be killed with arsenical poisons.

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HELLEBORE.

Fresh White Hellebore, 1 once.
Water, 5 gallons.

Hellebore is often employed in cases where arsenical poisons would be objectionable. For insects that chew, and especially for the currant and cabbage worms.

PYRETHRUM OR BUHACH.

Pure fresh Pyrethrum, 1 once,
Water, 5 gallons.

Valuable against both chewing and sucking insects, especially upon maturing fruits or vegetables, and upon flowering plants. It can also be applied in a powder form with a bellows.

CAUTIONS.

The copper solution should be made in wood, glass or earthen vessels, and should not be prepared in iron or tin.

Care should be taken against spraying plants of any kind with lime or poisonous mixtures within four or five weeks of the time they are to be used as food.

Study carefully the nature of the insect or disease and select the remedy that is most likely to destroy it without injuring the plants.

Do not spray while the trees are in blossom as the bees will be destroyed; they help to fertilize the flowers.

Pumps for the application of insecticides and fungicides should be sufficiently powerful to cover the trees or plants with a fine mist, and where copper compounds are to be used, the working parts should be of brass, and if all portions that are to come in contact with the spraying mixture are of brass, the durability of the pump will be greatly increased.

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VARIETY TESTS OF FRUIT.

O. M. Morris.

APPLES.

The following varieties set fruit in 1900:

American Summer Pearmain, Arkansas Beauty, Arkansas Black, Bledsoe, Black Annette, Black Warrior, Carolina Watson, Chester's Early White, Cole's Quince, Cullen's Keeper, Dickinson, Duchess, Duchess of Oldenberg, Early Harvest, Early Pennock, Enormous, Fallawater, Fanny, Fenley, Flory's Bellflower, Gano, Hightop Sweet, Indian, Jewett's Best, Jones' Seedling, Kansas Queen, Kentucky Red Streak, Keswick Codlin, King, Kittagaskee, Late Strawberry, Limbertwig, Little Romanite, Lowell, Maiden's Blush, Missouri Pippin, Moon, Nantahalle, Nickajack, Northern Sweet, Oldenberg, Orchard Red, Plumb Cider, Pomeroy, Pyle's Red Winter, Red Winter Pearmain, Shockley, Stewart's Golden, Stump, Trenton's Early, Twenty Ounce, Wagner, Water.

The following varieties bloomed but set no fruit :

Chattahoochee, Chenango Strawberry, Early Ripe, Elkhorn, Huntsman, Ingram, Lauren's Greening, Minkler, Nero, Primate, Rebel, Rhodes' Orange, Roman Stem, Tuscaloosa, Vandever, White Pippin, White Spanish Rennett.

PEARS.

The following varieties set fruit in 1900.

Bartlett, Kieffer, Clapp's Favorite. Duchess bloomed but set no fruit.

CHERRIES.

The following varieties set fruit in 1900:

Belle de Choisey, Dye House, Early Richmond, English Morello, Montmorency, Olivet.

PLUMS.

The following varieties set fruit in 1900:

Botan, Burbank, Emerson, Forest Garden, Golden, Beauty, Hattankio, Mrs. Clifford, Newton, Ogon, Pottawattamie, Weaver,

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Wolf's Free Stone, Wooten, and Yosebe. Lone Star bloomed but set no fruit.

APRICOTS.

The following varieties set fruit in 1900:

Alexander, Early Golden, Gibbs, Golden Russian, J. L. Budd, Jackson, Luizet, and Oldberg.

PEACHES.

The following varieties set fruit in 1900:

Alexander, Alice Haupt, Arkansas Traveler, Barnes, Becquett's Cling, Becquett's Free, Bell's October, Bishop, Bonanza, Champion, Champion Mark, Chinese Cling, Cobbler, Crimson Beauty, Crothers, Druid Hill, Early Rivers, Early York, Eldred Cling, Gen. Taylor, Haynes' Surprise, Heath Cling, Heath Free, J. B. Cling, June Rose, Mamie Ross, Miss Lolo, Mountain Rose, Mrs. Brett, Raisin, Ringgold, Salaway, Scruggs, Stump, Sylphide, Thurber, Topaz, Utah Cling, Walker, Wonderful, and Yellow St. John.

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TREE PLANTINGS.

The forestry plantation of the station has been extended, a piece of rough ground unsuited for cultivation being utilized for this purpose. The following summary of trees set in February, 1900 is of interest. The yearling seedlings were set in rows four feet apart and from two to four feet apart in the row.

KIND.	No. set.	No. Living June 1, 1900.	Per ct. dead.
White elm	9000	7650	15
Soft maple	5000	4900	2
Catalpa	5000	4750	5
Black locust	5000	4850	3
Box elder	5000	4500	10
White ash	3000	1050	65
Honey locust	3000	1200	60

Tree Plantings At Station.

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The elms were in poor condition when set out and under normal conditions, a larger per centage would probably survive. The seedlings were purchased at a cost of $3.00 per thousand. The accompanying engraving shows a portion of this year's planting in the foreground. The rest of the picture shows the growth attained in two years.

Clean cultivation is given so long as it is possible to get through the rows with a horse. A portion of the planting is trimmed and thinned as the trees become larger, another is trimmed but not thinned, and another is allowed to grow without attention. The different kinds are planted after a definite plan and arranged so as to furnish data later as to the effect of environment on the growth.

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STOCK FEEDING.

F. C. Burtis.

It is generally conceded that stock husbandry is the most profitable branch of farming, and that for agriculture to be on a substantial and profitable basis in a given locality, enough stock should be kept on every farm to consume the greater part of the products produced there. Still it is a fact that many thousands of dollars are lost every year in Oklahoma upon poor stock and through improper methods of feeding. This is not any more true here than in many other localities. Oklahoma has made rapid progress in the stock industry, but there is still much room for improvement. At the present time too much of the stock of Oklahoma is shipped out to be finished elsewhere. With her mild winters, and great variety of feeds in abundance, no other section should excel her in the production of the finished article.

But the time has passed when stock feeding can be carried on in an ignorant and haphazard way and afford the feeder much profit. The successful stockman must be able to discriminate between good and poor animals, and use the information that is given him on the composition and digestibility of feeds, and be able to combine them in the most economical form so as to produce the best gains or largest yield of products for the feed consumed. In other words he must know something of the science of stock feeding. He should know why a pound of alfalfa, if properly used is worth two to three times as much as a pound of prairie hay, and about four-fifths as much as a pound of bran, or how a ton of cotton seed meal can be made to yield $45 per ton, when corn is worth twenty-eight cents per bushel; or why a number of pounds of a certain mixture of feeds will produce a third more gain in growth than the same number of pounds of a different mixture when fed to the same animal.

For a good many years scientists have been at work solving these problems for the farmer, and of late years the results have been greatly simplified, so that now a school boy can understand them, and the number of farmers that are utilizing the information that is given in the published feeding tables and standards, is increasing rapidly every year, but still the number is not as large as it should be.

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COMPOSITION OF ANIMALS.

The animal body that the farmer is endeavoring to produce is made up of a class of substances very similar to those found in plants, and these are grouped under the heads; water, ash or mineral matter, fat, and protein or nitrogenous matter. The plant is the source from which the animal obtains these ingredients with the exception of water and that only in part comes from the plant.

COMPOSITION OF FEEDS.

In addition to the four groups of substances, water, ash, protein, and fat, which are found both in animals and plants, there is an additional group, called carbohydrates, found only in plants.

Water. From 40 per cent to 60 per cent of the animal body consists of this, and it is found in all feed stuffs, varying in amount from 10 per cent to 90 per cent. Dry clover hay contains about 20 per cent, field cured corn stover 40 per cent, and sugar beets 90 per cent. As a rule the water in the feed has no more value than the water from the well, and generally the higher the water content of a feed, the less its value per ton, but there are times when a little succulent feed as silage or sugar beets is very important. Aside from this the value of a feed is figured on the water-free content and the water in a feed has no value. The term dry matter is applied to the part of the feed after all the water in it has been driven off by an artificial heat.

Ash. This is the part left after burning the plant. It is the source of the mineral matter of the body and as such is important. While there is only a small per cent of it in plants, the ordinary mixtures of feeds contain it in sufficient quantity for the requirements of the animal in the majority of cases. The rough feeds, such as the hays, contain a much larger per cent than the grains. Young pigs fed exclusively on corn will not receive sufficient ash for proper growth. This is one of the very few examples where it may be lacking in sufficient quantity. It is quite essential that it be present in the feed of growing animals in sufficient quantity, as it enters largely into the growth of the skeleton.

Protein is a name applied to a group of substances found in plants and animals, and to which great importance is attached, because they are the only substances in plants and animals that contain nitrogen, hence the term nitrogenous group that is sometimes applied to them. The white of egg and casein of milk are good

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examples of animal matter belonging to this group, and the gluten of wheat is an example of vegetable matter. All feeds contain some protein, but some a much larger per cent than others. Most of our common feeds raised on the farm are deficient in it, and do not furnish the proper amount to give the best results in feeding. Protein in the feed is used by the animal system in forming milk, wool, muscle, and hair, and in fact all the working machinery of the body and all other slbstances containing nitrogen, and is absolutely indispensable in the formation of these as no other substance can take its place, no matter in what quantities furnished. Hence protein is very essential in the feeds of growing animals and others, whose functions or work require the formation of the above products.

Such feeds as cotton seed meal, linseed oil meal, and soy bean meal are very rich in protein, cotton seed, bran, clover hay and alfalfa are moderately rich in it, while Kafir and corn stover, prairie hay, and millet hay contain only very small per cents. The above is the reason why such feeds as cotton seed meal, linseed meal, etc., command high prices on the market; as it is generally the per cent of digestible protein that a feed contains that determines its feeding value.

Carbohydrates, comprise a group of substances rich in the element carbon. As was noted this group does not appear in the animal body. In the plant it constitutes the fiber, sugar, starch, and gums and similar substances. The function of carbohydrates in the animal body is to furnish heat, energy, and to build up the fat of the body. All our common feeds contain it in large quantities, and of the rough feeds as hay and fodders, over 90 per cent. of the digestible portions are carbohydrates, and all feeds contain a much larger per cent. of them than of any other ingredient. Present in such abundance it is a cheap article in the food and the feeder does not need to concern himself much about it only to see that it is present in the proper proportion with the protein.

Fat. The form in which this appears in the body is familiar to every one. It is stored up there for future use by the animal system. In the plants it is the fatty matter, as oils and some of the gums. It is so similar to the carbohydrates in composition and the function it performs that it might have been considered under that head. It is, however, more easily utilized by the system than the carbohydrates and it has been found to be worth 2 1-4 times as much for the animal's use. So, in finding the value of a feed the fat is mul-

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tiplied by 2 1-4 and added to the carbohydrates. In feeding the tables the fat and carbohydrates are combined in this way and given in one column.

UNDERSTANDING FEEDING TERMS

There has been some difficulty with farmers grasping the meaning of some of these terms because they are new to them, but there should not be as they are as simple as the word "water" and carry as much meaning.In practical work one does not think of the elements that go to make up water, and neither is it necessary with these terms. Think of protein for instance as the name of a group of substances found in feeds and realize the part it plays in the animal organism, and that nothing else can be substituted for it. Animals will die without water and will not make the proper growth without enough of it; the same is true of protein. When the farmer looks at these terms in this way he will have no more trouble in comprehending them.

TERMS USED IN FEEDING.

The scientist has found that for the proper and most rapid growth of animals, or the largest production of milk, wool, etc., the foregoing substances which are called food nutrients, must be present in the food of animals in certain proportions; these proportions vary with the age of the animals and the uses to which they are put.

Now the balanced ration that the farmer has heard more or less about, is nothing more than a ration in which the feeds are so mixed as to furnish these food nutrients in the proper proportions and amounts. The nutritive ratio of a feed is an expression of the relation of the digestible protein contained to the digestible carbohydrates and fat equivalent, and is determined by multiplying the fat by 2 1-4 and adding it to the carbohydrates, and dividing the sum by the number of pounds or per cent. of protein. This designates how many pounds of carbohydrates and fat equivalent there are to each pound of protein. For instance if the sum of the carbohydrates and fats divided by the protein equaled 6, it would mean that there was one pound of the latter to every 6 lbs. of the former and would be expressed 1:6. The nutritive ratio is spoken of as being wide, or narrow, and the same terms are applied to a ration. The terms have reference to the proportion of the protein to the carbohydrates and fat. For example, in alfalfa where there are

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3.8 lbs. of carbohydrates and fat for each pound of protein, the nutritive ratio is very narrow and in corn stover where there are about 20 lbs. of carbohydrates to each pound of protein, the nutritive ratio is very wide.

FEEDING STANDARDS.

The results as determined by scientists as to how much of the different food nutrients animals must have under different conditions, have been tabulated and are called feeding standards. They are not given as inflexible rules but as guides to the farmer and will need altering in cases. These are given in table one. Column one, designated dry matter is given to aid the feeder in giving the proper bulk of food to the animal. It includes all the feeding ingredients minus the water. The figures given in the various columns are given for animals of a certain weight but may be calculated to animals of any weight.

DIGESTIBILITY OF FEEDS, AND FEEDING TABLES.

Not all the ingredients in a feed are digested, and as only the digested portion can be utilized by the animal system, in feeding tables only the per cent of digestible ingredients, the portion of value to the animal, is given. These per cents have been determined after many actual feed-trials with the work of the chemist. The results given are the averages of many determinations and of feeds in normal condition. If feeds are neglected and left to bleach in the weather or become damaged otherwise, they will not contain nearly as high a feeding value as is given in the table. Table two gives the digestible nutrients of feeds in the reach of Oklahoma farmers. The only explanation that the table needs is that the work of combining the fats and carbohydrates has been performed and the result placed under one column.

MIXING FEEDS ACCORDING TO FEEDING STANDARDS.

First, the feeder must refer to the feeding standards and find under what class the animal comes that he has to feed and what proportion and amount of the food nutrients are required. Is it an animal that requires a larger proportion of protein or not? If it is he must count on using some food rich in protein. The feeder should select feeds within his reach and those that he thinks will give the desired results, always giving due consideration to the market value of each. Determine the number of pounds of the feeds that

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the animal should have, and then refer to table two of digestible nutrients and figure out the pounds contained in each feed selected. Compare the totals with the numbers found required for the animal according to the feeding standard. If the ration does not furnish the nutrients in the required proportion and amounts, reduce the feed that does not seem to furnish enough protein, or vice versa, and add one that contains more protein or less corbohydrates. Continue this adjustment until the digestible nutrients in the ration approximate those required in the standard, and the ration would be said to be a balanced ration and the nutritive ratio a proper one. The following example may help to make the method clear. A bunch of steers, averaging 900 pounds are to be fattened. Calculate the ration per head and per day. Referring to the feeding standard to get the nutrients, we find that for a 1000 lbs. steer, is required dry matter 27 lbs., protein 2.5 lbs., carbohydrates and fat equivalent 16.1, substracting 10 per cent from each one of these as the steer is 10 per cent lighter than the one given in the standard, we have the following: Dry matter 24.3 lbs., protein 2.25 lbs., carbohydrates and fats 14.49 lbs. Take a common ration for a steer of this size, 24 lbs. corn and 12 lbs. corn stover. Referring to the feeding tables we find the following for the corn:

Dry matter per cent 8.91x24 equals 21.36 lbs.
Protein per cent 7.9x24 equals 1.89 lbs.
Carbohydrates and fat 76.4x24 equals 18.33 lbs.

The same table gives us for corn stover:

Dry matter per cent 59.5x12 equals 7.20.
Protein per cent 1.7x12 equals .204.
Carbohydrates and fat 32.4x12 equals 3.9.

Tabulating the above we have the following:

	Dry Matter—lbs.	Digestible: Protein—lbs.	Digestible: Carbohydrates and fat—lbs.	Nutritive Ratio.
24 lbs. corn contains	21.36	1.89	18.33	1: 9.7
12 lbs. corn stover	7.2	.204	3.9	1:19.9
Total contained	28.56	2.1	22.23	1:10.6
Required amount	24.3	2.25	14.49	1: 6.4

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The important points to notice are that the protein lacks practically 1-4 lb., and the carbohydrates are about 8 lbs. too much, which makes 10.6 lbs. of carbohydrates to each pound of protein when there should be only 6.4 lbs. The dry matter should be at least two pounds less. With the nutrients in this proportion the steer would not make as rapid gains and it would take more pounds of feed to make a pound of gain than if the proportion of protein were nearer the carbohydrates.

The ratio could be remedied as follows: Reduce the corn to 14 pounds and add 4 pounds of cotton seed, reduce the corn stover to 5 pounds and add 6 pounds of alfalfa hay. Referring to table two for the per cent of digestible nutrients in these feeds and making the computations as before we have the following:

	Dry Matter.	Digestible:		Nutritive Ratio.
		Protein.	Carbohydrates and fat.	
14 lbs. corn	12.46	1.106	10.69	1: 9.7
4 lbs. cotton seed	3.58	.5	1.2	1: 5.9
5 lbs. corn stover	3	.085	1.72	1:19.9
6 lbs. alfalfa	5.52	.66	2.53	1: 3.8
Total	24.56	2.351	16.14	1: 6.8
Required amount	24.3	2.25	14.49	1: 6.4

Both the protein and the carbohydrates are a little too high and the nutritive ratio a trifle wide, but near enough for practical purposes. On this ration the steer would make larger gains and on less grain per day.

The following comparison taken from the steer feeding experiments of the past winter at this station will illustrate the value of an approximate balanced ration as compared with one carrying too large a proportion of carbohydrates, known as a wide ration.

Five steers were fed on corn meal and alfalfa hay and five on corn meal and Kafir corn stover. Taking the average number of

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pounds of feed per day and per head and determining the nuturients in each, we have the following:

	Dry Matter.	Digestible: Protein.	Digestible: Carbohydrates and fat.	Nutritive Ratio.
17.84 lbs. corn meal	15.88	1.36	13.62	
12.87 lbs. alfalfa hay	11.84	1.39	5.33	
Total	27.72	2.75	18.95	1: 6.9
18.67 lbs. corn meal	16.61	1.47	14.26	
10.33 lbs. Kafir corn stover	8.35	.15	4.52	
Total	24.96	1.62	18.78	1:11.6
Standard required	29.7	2.75	17.71	1: 6.4

The nutrients given as required are for a 1100 lb. steer. The steers were feed all the alfalfa hay and Kafir stover they would eat and more or less waste was left, but only the actual amount that they did eat was considered in the ration. The corn meal alfalfa fed steers required 30½ per cent less grain to produce a pound of gain, and gained .53 of a pound more per head each day, than the corn meal Kafir stover fed steers.

The fact should not be overlooked that there are cases where the balanced ration is not the most economical. This will be influenced by the relative market price of feeds and the animals that are to be fed. For instance if corn is very cheap the feeder will not be justified in paying high prices for mill stuff to feed in very large quantities to fattening steers, unless it be for the finishing period. The carbohydrates that he would waste are too cheap in 15 cent corn to justify him to buy high priced protein to save them. But generally, feed containing enough protein at a reasonable price can be had on the farm at a price that will justify an approximate balanced ration in the majority of cases. Besides the loss of food nutrients, there are detrimental results caused by an unbalanced ration. Growing stock are stunted; dairy cows are dried up, in breeding stock the animal system is weakened, etc. For such cases as these the balanced ration will pay, even if it is necessary to purchase such feeds as oil meal, etc., that are generally considered high priced.

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SOME OKLAHOMA FEEDING STUFFS.

COTTON SEED AND ITS PRODUCTS.

The cotton plant furnishes some very valuable food products.

The seed is quite rich in protein and contains some 3½ pounds more per hundred than corn. The use of it could be greatly increased with profit amoung farmers. It is not practical to feed it to hogs as it requires special preparation for them, but gives the best results when mixed with corn and fed to cattle.

Cotton seed meal, the product from the oil mills, is very rich in protein; in fact contains more protein than any other feed. All stock relish it and do well on it when mixed with other feeds, but it must be fed with great precaûtion to hogs, as after four weeks feeding on it, they commence dying. This station has been successful in feeding it to hogs without fatal results, by discontinuing the cotton seed meal after four weeks feed, for about two weeks, and then adding the cotton seed meal again for four weeks and so on.

Dairy cows should not be fed more than 2 to 3 pounds of it per day, and steers not more than six to eight for the best results. Steers when fed large quantities longer than 80 to 90 days go blind.

Cotton seed hulls are a dry and tasteless article of low feeding value, but have a value to the feeder as they can be readily mixed with various meals to be fed to cattle, and furnish that divisor that is so necessary with such heavy foods as meals.

COWPEAS.

While the grain of this plant contains a rather large per cent of protein, it is not economical to try and harvest it separately for feeding, but the whole plant should be utilized as hay or pastured off in the field. In this condition, it is much richer in protein than our common rough feeds and makes a valuable addition to them to help balance the ration.

SOY BEANS.

This plant should be grown for the grain it produces as it contains about 30 per cent of protein, and is relished by all stock and can be fed to them with other grain, in proper proportions, with great profit. The plant has little value as hay but its erect growth enables it to be harvested for the grain with machinery. The plant does well in Oklahoma.

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WHEAT BRAN.

This feed can generally be purchased at a price to justify quite an extensive use of it. It is valuable for the protein it contains and other beneficial effects on the animal system. It is very valuable to mix with feed for breeding stock.

ALFALFA.

This is one of the most valuable feeds grown on the farm and it does well quite generally over Oklahoma. Besides being a very palatable feed, it contains almost as much protein as bran and will give about as good results in feeding. This makes it quite a valuable crop when we consider that three to four tons of hay per acre can be harvested yearly. It is relished by all stock and it is a very economical feed to put in to balance the ration. Even the dry hay is eaten by swine and much better gains are obtained where it is fed in addition to corn, than where corn alone is fed. This is especially true with shoats.

SUGAR BEETS AND MANGLES.

As a source of succulent feed in the winter, these are very valuable. In Oklahoma where green pasture can be had the winter through, they are not as essential as in the north. At no time should breeding stock be without succulent food as part of the ration at least. When the brood sow has not access to pasture, a sugar beet or two a day will go a great way towards bringing a healthy litter. For stock feeding beets and mangles can be raised successfully in Oklahoma.

CORN.

This is pre-eminently the American stock food. Besides carrying a fair amount of protein, there are in every 100 lbs., 76.4 lbs. of digestible carbohydrates and fat equivalents, with the protein making a total of 84.3 lbs. food nutrient equivalents in each one hundred pounds of grain. It is a highly carbonaceous feed and in the majority of cases some feed richer in protein should be mixed with it to give the best results.

KAFIR CORN.

While superior to corn as a plant to grow on poor soil and to resist drouth, it is not equal to corn in feeding value. It is very similar to corn in composition but it is not nearly as digestible. It should be ground in the majority of cases to obtain the best results.

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TABLE I—FEEDING STANDARDS. A.—*Per Day and 1,000 lbs. Live Weight.*

ANIMAL.	Dry Matter.	DIGESTIBLE: Protein	Carbohydr's.	Total.	Nutritive Ratio.
HORSES—					
Light work	20	1.5	10.5	12	1:6.9
Medium work	24	2	12.35	14.35	1:6.2
Heavy work	26	2.5	15.3	17.8	1:6
FATTENING CATTLE—					
Preliminary period	30	2.5	16.1	18.6	1:6.5
Main period	30	3	16.1	19.1	1:5.4
Finishing period	26	2.7	16.6	19.3	1:6.2
MILCH COWS—					
When yielding daily 11.0 lbs. of milk	25	1.6	10.7	12.3	1:6.7
16.6 lbs. of milk	27	2	12	14	1:6
22 lbs. of milk	29	2.5	14.1	16.6	1:5.7
27.5 lbs. of milk	32	3.3	15	18.3	1:4.5
SHEEP—					
Coarse wool	20	1.2	11	12.2	1:9.1
Fine wool	23	1.5	12.7	14.2	1:8.5
Breeding ewes	25	2.9	16.1	19	1:5.6
FATTENING SHEEP—					
First period	30	3	16.1	19.1	1:5.4
Second period	28	3.5	15.9	19.4	1:4.5
FATTENING SWINE—					
First period	36	4.5	26.5	31	1:5.9
Second period	32	4	25.1	29.1	1:6.3
Third period	25	2.7	19	21.7	1:7
BROOD SOWS	22	2.5	16.5	19	1:6.6

TABLE I—FEEDING STANDARDS. B.—*Per Day and Head.*

ANIMAL.	Age—months.	Average live wt. per head.	Dry Matter.	DIGESTIBLE: Protein.	Carbohyd'tes	Total.	Nutritive Ratio.
Growing Animals	2–3	150	3.3	.6	2.8	3.4	1:4.6
	3–6	300	7	1.0	4.9	5.9	1:4.9
	6–12	500	12	1.3	7.5	8.8	1:6
	12–18	700	16.8	1.4	9.7	11.1	1:7
	18–24	850	20.4	1.4	11.1	12.5	1:8
Growing Sheep	5–6	56	1.6	.18	.974	1.154	1:5.4
	6–8	67	1.7	.18	.981	1.161	1:5.4
	8–11	75	1.7	.16	.953	1.113	1:6
	11–15	82	1.8	.14	.975	1.115	1:7
	15–20	85	1.9	.12	.955	1.075	1:8
Growing Fat Swine	2–3	50	2.1	.38	1.5	1.88	1:4
	3–5	100	3.4	.5	2.5	3	1:5
	5–6	125	3.9	.54	2.96	3.5	1:5.5
	6–8	170	4.6	.58	3.47	4.05	1:6
	8–12	250	5.2	.62	4.05	4.67	1:6.5

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TABLE II—DIGESTIBLE NUTRIENTS IN FEEDING STUFFS.
Pounds in 100 lbs. of Feed.

	Dry Matter.	DIGESTIBLE:			Nutritive Ratio.
		Protein	Carbohydrates and fat.	Total.	
CONCENTRATES.					
Corn	89	7.9	76.4	84.3	1: 9.7
Wheat	90	10.2	73	83.2	1: 7.2
Wheat bran	88	12.2	45.3	57.5	1: 3.7
Wheat shorts	88.2	12.2	58.5	70.7	1: 4 8
Brewer's grain, wet	24	3.9	12.5	16.4	1: 3.2
Brewer's grain, dry	92	15.7	47.8	63.5	1: 3
Oats	89	9.2	56.8	66	1: 6 2
Sorghum seed	87.2	7	59.1	66.1	1: 8.4
Broom-corn seed	85.9	7.4	54 8	62.2	1: 7.4
Kafir corn, whole	87.5	4.7	32 6	37.3	1: 6.9
Kafir corn, coarsely ground	87.5	5.8	56.5	62.3	1: 9.8
Kafir corn heads	78.4	1.03	21.5	22.5	1:20.9
Millet	86	8.9	52.2	61.1	1: 5.9
Flax seed	90.8	20.6	82.3	102.9	1: 4
Linseed oil meal, old process	91	29.3	48.5	77.8	1: 1.7
Cotton seed	89.7	12.5	68.9	81.4	1: 5.5
Cotton seed meal	92	37.2	44.4	81.6	1: 1.2
Cotton seed hulls	88.9	.3	36.9	37.2	1:12.3
Sunflower seed	92.5	12.1	85.8	97.9	1: 7.1
Peanut meal	89.3	42.9	38.3	81.2	1: 0.9
Peas	90	16 8	53.4	70.2	1: 3.2
Soy beans	89.2	29.6	54.9	84.5	1: 1.8
Cowpeas	85.2	18.3	56.7	75	1: 3.1
ROUGHAGE.					
Fodder corn, field cured	58	2.5	37.3	39.8	1:14.9
Corn stover, field cured	60	1.7	34	35.7	1:19.9
Kafir fodder	90.3	2.1	53.49	55.6	1;24.9
Kafir stover	80.8	1.5	45.3	46 8	1:29.6
Red clover, medium	84.7	6.8	39.6	46.4	1: 5.8
Red clover, mammoth	78.8	5.7	36.3	42	1: 6.4
Alfalfa	92	11	42.3	53.3	1: 3.8
Cowpea hay	89.3	10.8	41.1	51.9	1: 3.8
Soy bean hay	88.7	10.8	43.1	49.5	1: 4
Timothy	87	2.8	46.5	49.3	1:16.6
Orchard grass	90.1	4.9	45.4	50.3	1: 9.3
Redtop	91.1	4.8	49.1	53.9	1:10.2
Mixed grasses	87.1	5.9	43.7	49.6	1: 7.4
Prairie grass	85	3.5	45	48.5	1:12.8
Oat hay	91.1	4.3	49.8	54.1	1:11.6
Oat straw	90.8	1.2	40.4	41.6	1:33.6
Wheat straw	90	.4	37.2	37.6	1:93
Rye straw	92.9	.6	41.5	42.1	1:69
Barley straw	85.8	.7	42.5	43.2	1:61
ROOTS AND TUBERS.					
Potato	21	.9	16.5	17.41	1:18.3
Beets, sugar	13	1.1	10.4	11.5	1: 9.4
Mangels	9	1.1	5.6	6.7	1: 5.1
Flat turnip	9.5	1	8.5	9.5	1: 8.5
Artichokes	20	2	17.2	19.2	1: 8.6
MISCELLANEOUS.					
Pumpkins	9.1	1	6.5	7.5	1: 6.5
Rape	14	1.5	8.5	10	1: 5.7
Milk	12.8	3.6	13.2	16.8	1: 3.7
Skim milk	9 6	3.1	6 5	9.6	1: 2.1
Buttermilk	10	3.9	6.5	10.4	1: 1.7
Whey	6.6	.8	5 4	6.2	1: 6.7

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FINANCIAL REPORT OF THE OKLAHOMA AGRICULTURAL EXPERIMENT STATION.

FOR THE YEAR ENDING JUNE 30, 1900.

Dr.

To Receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1900, as per Act of Congress approved March 2, 1887, $14999.07.

Cr.

By Salaries	1	$ 5245.00
Labor	2	2801.28
Publications	3	692.61
Postage and Stationery	4	432.24
Freight and Express	5	221.92
Heat, Light and Water	6	548.95
Chemical Supplies	7	82.79
Seeds, Plants and Sundry Supplies	8	692.10
Fertilizers	9	9.74
Feeding Stuffs	10	581.87
Library	11	3.32
Tools, Implements and Machinery	12	154.10
Furniture and Fixtures	13	487.00
Scientific Apparatus	14	558.32
Live Stock	15	1421.29
Traveling Expenses	16	296 54
Contingent Expenses	17	20.00
Building and Repairs	18	750.00
Total		$14999.07

We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the Oklahoma Agricultural Experiment Station for the fiscal year ending June 30, 1900; that we have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $14999.07 and the corresponding disbursements $14999.07; for all of which

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proper vouchers are on file and have been by us examined and found correct, thus leaving no balance.

And we further certify that the expenditures have been solely for the purposes set forth in the Act of Congress approved March 2, 1887.

(Signed:)

FRANK J. WIKOFF,
C. J. BENSON,
J. C. TOUSLEY,
Auditors.

Attest:

HENRY M. HAND, Custodian.

SUPPLEMENTARY STATEMENT.

Receipts and disbursements of Station Sale Fund.

Dr.

July 1, 1899, Balance	$ 1868.35
To receipts from sale of station products	2027.56
Total	$ 3895.91

Cr.

By Labor	$121.35
Freight and Express	6.35
Heat, Light and Water	684.20
Seeds, Plants and Sundry Supplies	3.75
Feeding Stuffs	56 22
Tools, Implements and Machinery	5.45
Live Stock	10.00
Traveling Expenses	20.00
Building and Repairs	2063.75
Balance	924.84
Total	$3895.91

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Oklahoma Agricultural Experiment Station, United States Appropriation, Expenditures 1892–1900

Year.	Salaries.	Labor.	Publications.	Postage and Stationery.	Freight and Express.	Heat, Light, and Water.	Chemical Supplies.	Seeds, Plants, and Sundry Supplies.	Fertilizers.	Feeding Stuffs.	Library.	Tools, Implements and Machinery.	Furniture and Fixtures.	Scientific Apparatus.	Live-Stock.	Traveling Expenses	Contingent Expenses.	Building and Repairs.
1892	$2414 19	$2493 64	$ 208 90	$ 63 12	$361 30	$ 991 10	$1390 80	$695 51	.....	$ 88 24	$ 220 12	$1637 48	$441 55	.....	$ 300 00	$ 599 66	$149 87	$3000 00
1893	4914 80	2878 57	460 50	99 80	189 09	175 68	1713 68	316 37	.....	497 81	92 55	863 96	108 95	.....	120 82	1318 43	181 20	750 00
1894	3529 40	5516 06	512 50	116 94	300 12	1047 81	1143 38	128 80	.....	183 70	349 22	70 54	154 34	.....	120 00	642 20	186 68	699 25
1895	5626 66	4205 46	857 56	352 86	100 72	1076 83	147 46	409 99	$ 3 99	282 22	16 75	377 18	211 00	$ 12 82	331 90	85 81	82 15	775 23
1896	4384 90	2950 33	600 50	190 18	230 02	73 53	291 58	719 24	.....	270 71	1009 50	605 97	478 91	1260 64	1316 27	104 58	10 00	748 57
1897	5180 04	3253 33	996 02	141 70	197 48	106 45	97 85	347 86	.....	252 80	3 00	378 22	590 96	1657 75	611 68	161 45	18 66	606 70
1898	5972 54	3569 25	1739 30	146 60	256 78	168 44	65 25	458 13	.....	501 74	.....	183 20	205 20	964 34	247 05	196 31	10 00	293 94
1899	6955 00	2931 55	2008 30	109 08	152 64	219 71	110 45	893 46	.....	397 92	2 00	190 65	165 67	219 83	61 40	220 07	10 00	750 00
1900	6245 00	2801 28	692 61	482 24	221 92	548 96	82 70	692 10	9 74	581 87	3 32	154 10	467 00	558 32	1421 29	296 54	20 00	750 00

PUBLICATIONS.

The following have been issued since the organization of the station. Copies will be sent in response to request so long as the supply lasts.

No. 1, Dec. 1891—General information, organization, and history.

No. 2, Mar. 1892—Record of progress and details of plans.

No. 3, June, 1892—Station notes, insects.

No. 4, Oct. 1892—Tests of varieties; oats, corn, spring wheat, Irish and sweet potatoes.

No. 5, Jan. 1893—Some soil analyses.

No. 6, May, 1893—Notes of progress; analyses.

No. 7, July, 1893—Water analyses.

No. 8, Oct. 1893—Tests of varieties of wheat.

No. 9, Jan. 1894—Tests of varieties of vegetables, 1893.

No. 10, Apr. 1894—Corn—report of experiments.

No. 11, July, 1894—Press bulletin excerpts.

No. 12, Sept. 1894—Wheat—report of experiments.

No. 13, Dec. 1894—Wheat feeding.

No. 14, Jan. 1895—Grapes, 1894.

No. 15, Feb. 1895—Garden vegetables, 1894.

No. 16, Mar. 1895—Oats—report of experiments.

*No. 17, Dec. 1895—Oklahoma weeds.

No. 18, April, 1896—Irrigation for Oklahoma.

No. 19, Apr. 1896—Methods of destroying chinch bugs.

*No. 20, June, 1896—Wheat experiments, 1895-6; Food value of corn scorched by hot winds; Fruit culture in Oklahoma; Peach rosette; The melon louse.

No. 21, Sept. 1896—Experiments in corn culture, 1896; Road making and reparing.

No. 22, Jan. 1897—Climate and crops in Oklahoma; Field experiments with Kafir corn.

No. 23, Feb. 1897—Cotton culture in Oklahoma.

No. 24, May, 1897—Oklahoma soil studies.

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No. 25, June 1897—Loss by exposure of corn stover and teosinte; Composition of pie melon; Fertilizer analyses of castor bean plant.

*No. 26, June, 1897—Some insects injurious to orchards.

No. 27, June, 1897—Glanders, Texas fever, and symptomatic anthrax.

No. 28, June, 1897—Experiments with wheat, 1896-7.

No. 29, Sept. 1897—Study of waters for irrigation; the irrigation plant.

No. 30, Jan. 1898—Oklahoma weather and crops for 1897.

*No. 31, Feb. 1898—Strawberries; grapes; stimulating and holding fruit buds.

No. 32, Mar. 1898—Practical chemistry of soils and crops; study of the castor oil plant.

No. 33, Mar. 1898—Experiments with field crops, 1897.

No. 34, May, 1898—The San Jose scale in Oklahoma.

No. 35, Nov. 1898—Summary of digestion experiments with Kafir; Notes on feeding experiments.

No. 36, Nov. 1898—Summary of experiments with corn and wheat, 1898.

No. 37, Apr. 1899—Digestion experiments and fodder analyses.

No. 38, Apr. 1899—Analyses of waters for irrigation.

No. 39, May, 1899—Texas fever.

No. 40, May, 1899—Bacteriology of milk.

No. 41, May, 1899—Weeds of Oklahoma.

No. 42, June, 1899—Oklahoma soil studies.

Annual Report, 1898-99.—Summary of results of previous work of the station.

No. 43, Nov, 1899—Fruits for Oklahoma.

No. 44, Dec. 1899—Field crops, 1899.

No. 45, Mar. 1900—An Annotated catalogue of the ferns and flowering plants of Oklahoma.

No. 46, May, 1900—Digestion trials.

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*Out of print.

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INDEX.

A.

Admission to College 10
Agricultural department 7
Alfalfa 51-52, 129
feeding experiments 84-89
Analyses of wines 81-82
Anthracnose of grapes 104
Apples, varieties 54, 116
Apricots, " 55, 117

B.

Blackberries 55
Black-leg 59
Black rot of grapes 105-106
Books for farmers 46
Bordeaux mixture 113
Botany and entomology 7
Broom corn 52
Brown-backed skeletonizer 110
Brown louse 66
Brown rot of grapes 106-107
Buildings 17
Bulletins issued 16

C.

Castor beans, culture notes 36-39
Chemistry department 6
Cherries, varieties 54, 116
Chinch bugs, prepare for 55-56
infection 65
Climate of Oklahoma 33
Composition of animals 121
feeds 121
Cooking feed 58-59
Corn, culture notes 35
feeding experiments 84-89

Digitized by Google

Correspondence of station 17
Cotton, culture notes 35
in Oklahoma 50-51
seed for feeding 128
Cowpeas culture notes 40, 48, 128
Courses of study 8
Crops of Oklahoma 34
Cultivation 63
of grapes 93-94
Currants, varieties 55
Cut worms 65

D.

Digestibility of feeds 124
Director, report of 11-18
Diversified farming 33-44

E.

Equipment of college 6
Expenditures for sub-stations 11
Expenses of attending college 10

F.

Faculty of college 8
Farmers' institutes 18, 45-46
Feeding standards 124
tables 130, 131
Financial statement 132-134
Fruits 41
for Oklahoma 54-55
Fungicides and insecticides 113-115
Fungus diseases of grapes 104-107

G.

Grain louse 65
Grape berry moth 112
Grass for lawns 57
Grape growing 90-103
insects 108-112
leaf folder 58

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H.

Hay 40
Hellebore 115
Hog Cholera 29-32
Honey 60
Horticultural department 7

I.

Insecticides and fungicides 113-115
Insects affecting the grape 108-112
and remedies 64

K.

Kafir corn, culture notes 39-40
feeding experiments 84-89
weight of 52-53
fodder, method of using 47
Kerosene emulsion 114

L.

Language and literature 8
Lawn grasses 57
Library 6
Livestock 43-44

M.

Mailing list of station 17
Mathematics 8
Mechanical department 6
Mechanics 9
Melon louse 60-62
Mineral specimens 68-72
Minor crops 41

N.

Native grass 67
New plants 53-54

O.

Oats, culture notes 37
Orchard fruits 116

Digitized by Google

P.

Paris green 114
Pasture grasses 41
Peaches, varieties 54, 117
leaf curl 66
Peanuts 49-50
Pears, varieties 54, 116
Plums, " 54, 116
Pocket gopher, poison 64
Potassium sulfid 114
Potatoes, storing 56
Preparatory department 10
Prepare for chinch bugs 55-56
Preventing Texas fever 26-28
Progress of college 5
Propagation of grapes 90-92
Pruning grapes 94-97
Publications 135-136
Pure-bred bulls 42
cows 43

R.

Raspberries, varieties 55
Report of Director 11-18
Resources of college 5
Root rot 58
Rose chafer 111

S.

Science, pure and applied 9
Shade trees 56-57
Short winter courses 9
Sorghum 40-41
Sowing wheat 46-47
Soy beans 128
Special courses 10
Spotted vine chafer 109
Stable manure, value of 62-63
Station staff 18
Steer feeding 84-89
Stem borer 108

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Stock feeding 120
Storing potatoes 56
Subjects of investigation 14
Sub-stations 11
Sugar beets 60
Summary of press bulletins 45
Swine plague 29-32

T.

Terms used in feeding 123
Texas fever, prevention 26-28
Training grapes 99-103
Tree plantings 118-119
Trellis for grapes 97-99

V.

Variety tests of fruits 116
Veterinary science 7

W.

Water analyses 73-75
Weevel in wheat 57-58
Weight of Kafir corn 52-53
Wheat bran 129
culture notes 34-35
Wines and wine making 76-83
Wines, analyses of 81-82
Work of experiment station 19

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OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE

AGRICULTURAL EXPERIMENT STATION, STILLWATER, OKLA.

Tenth Annual Report

1900-1901.

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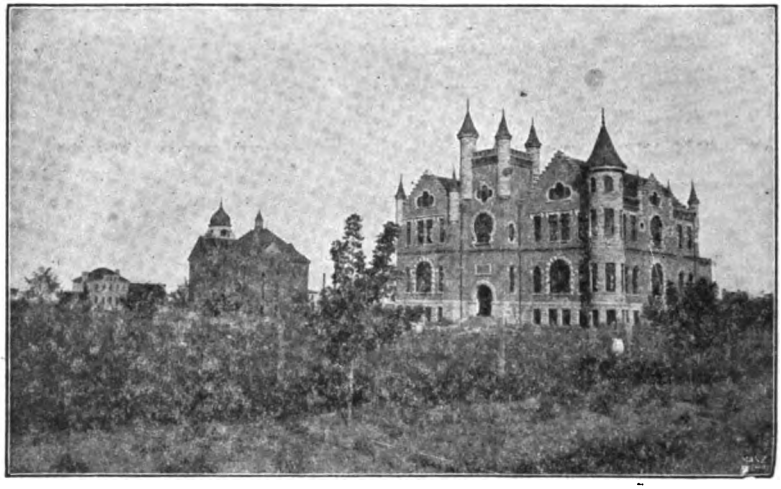

COLLEGE AND STATION BUILDINGS.

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AGRICULTURAL AND MECHANICAL

COLLEGE.

AGRICULTURAL EXPERIMENT STATION.

Tenth Annual Report, 1900-1901.

Stillwater, Oklahoma.

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Oklahoma Agricultural and Mechanical College,

Agricultural Experiment Station.

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E. M. WILCOX, Ph. D.....Botanist and Entomologist
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A. B. MCREYNOLDS, B. S.....Assistant in Chemistry
J. S. MALONE, B. S.....Assistant in Agriculture
H. M. HAND.....Clerk
MISS G. M. HOLT.....Stenographer

VISITORS ARE CORDIALLY WELCOMED AT ALL TIMES.

The publications of the Station are sent free to residents of the Territory on request. All communications should be addressed, not to individuals or departments, but to the

EXPERIMENT STATION, Stillwater, Oklahoma.

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LETTER OF TRANSMITTAL.

OKLAHOMA AGRICULTURAL EXPERIMENT STATION,

STILLWATER.

JOHN FIELDS, Director.

July 1, 1901.

Sir:—

I submit herewith the tenth annual report of the Oklahoma Agricultural Experiment Station, for the fiscal year ended June 30, 1901. In addition to a statement of the work which has been done during the year, and the financial statement as required by law, the report contains several articles on subjects that have a direct bearing on the agricultural interests of the Territory.

Very respectfully,

Governor Wm. M. Jenkins,
Guthrie, Oklahoma.

John Fields,
Director.

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OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE.

PROGRESS.

The record of the past year has been one of continued growth. The student body has increased in numbers to 405, and the equipment for instruction from $60,362.69 to approximately $75,000. Within the coming year the building equipment will be increased to the extent of about $50,000, including an auditorium, a mechanical hall, quarters for the department of botany and entomology, and the department of domestic economy, and a commodious modern barn for the department of agriculture.

RESOURCES.

The Oklahoma Agricultural and Mechanical College receives from the government every year the sum of $22,500. This is known as the "Morrill Fund," and is to be expended for instruction and appliances only, the Territory of Oklahoma providing buildings, repairs, etc.

The Agricultural Experiment Station, which is a department of the college, receives from the United States government, an annual appropriation of $15,000, to be used solely for experimentation and the publication of results. This is known as the "Hatch Fund."

The territorial law provides for the annual levy of one-tenth of a mill on the taxable property of the territory for the benefit of the college. This, on present valuations, reaches about $5,500. The law also sets apart one-fifth of the income derived from the rental on the lands granted to the territory for the benefit of the institutions of higher learning. This amounts to about $5,000 per year.

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There are other slight sources of income, not necessary to detail here, which raise the total annual income of the college and station to about $50,000.

EQUIPMENT.—GROUNDS AND BUILDINGS.

The college campus and experiment station grounds occupy 200 acres of land. Four buildings are now occupied for the purposes of instruction and experimentation: The Assembly building (containing the auditorium and lecture rooms;) the Library building (containing the library, lecture rooms, laboratories and museums of the department of biology;) the Chemistry building (containing lecture rooms and laboratories of the department of chemistry, and also the offices and the chemical laboratories of the experiment station;) and the Mechanical building (containing lecture room and shops of the mechanical department, and the printing office.)

The new building equipment mentioned under the caption "Progress" will probably not be ready for use before the fall of 1902, except the mechanical hall and the college barn, which are expected to be available by the middle of the coming academic year.

LIBRARY.

The college has a well selected library of 7,000 volumes. The books are kept in a fire-proof stack room, and a commodious reading room is provided immediately adjoining. Students are permitted under proper restrictions to take books to their rooms. The best reference books and the leading periodical publications are at the disposal of the students.

MECHANICAL DEPARTMENT.

The equipment of this department now includes a machine shop, a carpenter and pattern-making shop, a blacksmith shop, a foundry, and a drawing room, besides the electrical engineering laboratory, all of which are fully provided with the latest and best machinery, instruments, tools, and appliances.

DEPARTMENT OF CHEMISTRY.

This department is located in the new chemistry building, occupying the basement, a lecture room and office on the first floor, the entire second floor, and the attic—the remainder of the building be-

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ing occupied by the experiment station. The qualitative, quantitative, and private laboratories are fitted for the best possible service, and the department is equipped with the best modern apparatus, glassware, chemicals, analytical and assay balances, etc. Pressure of numbers has already rendered necessary the equipping of an additional laboratory in the new building.

DEPARTMENT OF BOTANY AND ENTOMOLOGY.

The apparatus in this department is all of recent make and of the best to be found on the market—including 28 simple and compound microscopes, hand lenses, microphotographic apparatus, camera facilities and slide mounts, collections of plants, insects, woods, fibers, seeds, etc.; wall charts, models, green-houses, etc.

DEPARTMENT OF ZOOLOGY AND VETERINARY SCIENCE.

The quarters of this department in the library building consist of a laboratory for general biological work, a bacteriological laboratory, a laboratory for special work, and a lecture room. Among the extensive equipment of the department are twenty compound Zeiss and Leitz microscopes, micrometers and cameras, microtomes, dissecting instruments, dissectible models of various types of animals, skeletons, prepared skins of birds and mammals, etc.

DEPARTMENT OF AGRICULTURE.

The equipment of this department has been substantially increased during the past year. The farm of 200 acres, with the experiments of the station continually under way, is its laboratory. Four breeds of cattle are represented, viz: Short-horns, Herefords, Aberdeen Angus, and Red Polls. The breeds of swine represented are Berkshires, Poland Chinas, Duroc-Jerseys, and Chester Whites; of sheep, Shropshire and Cotswold. A farm dairy will be equipped in time for next year's use.

DEPARTMENT OF HORTICULTURE.

This department is equipped with complete lines of garden seeders, tools for lawn work, spray pumps, garden tools, charts and models, herbarium, microscopes, etc. It has at its command, also, the extensive vineyards and orchards of the experiment station, including fifty thousand trees and vines, and, for instruction in forestry, a plantation of forty thousand forest trees.

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OTHER DEPARTMENTS.

The departments of English language and literature, of foreign languages, and of history and political economy, are properly supplied with facilities for instruction, and are represented with special fulness in the library. The department of mathematics has extensive appliances for demonstration, instruction, surveying, and other practical work. The printing office is suitably equipped for instruction, which is its primary purpose. The regular college publication, The College Paper, is issued by this department, under student management, and the general job work of the college, including the publication of the annual catalogue, is done by it. The department of stenography and typewriting is equipped with eight typewriters and other necessary appliances.

FACULTY.

The college has a faculty of twenty members, each specially trained in the department under his charge.

COURSES OF STUDY.

From the above statement it will be seen that the present facilities of the college are ample to give a high-grade practical higher education. Five courses are offered, all requiring four years (exclusive of the preparatory department) and all leading to the degree of Bachelor of Science:

I. General Science and Literature course.

I. Agricultural course—including Horticulture and Veterinary Science.

III. Mechanical Engineering course.

IV. Courses in Special Sciences:

1. Chemistry.
2. Biology—with majors in botany or zoology.

The branches pursued in the several collegiate courses may be summarized as follows:

LANGUAGE AND LITERATURE.

Rhetoric, Etymology and structure, theme work, English and American Literature, literary interpretation and criticism; German and Latin.

MATHEMATICS.

Algebra, geometry, descriptive geometry, trigonometry, surveying, analytical geometry, calculus.

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MECHANICS.

Electricity, magnetism, mechanical drawing, kinematics, steam boilers and engines, thermodynamics, machine design, wood-working, shop-work, blacksmithing, etc.

SCIENCE, PURE AND APPLIED.

Agriculture and horticulture, domestic economy, chemistry, physics, botany, entomology, zoology, comparative anatomy, general biology, physiology, geology, assaying, bacteriology, materia medica, normal and pathological histology, embryology, etc.

MISCELLANEOUS.

Elements of law, political and industrial history of the United States, English history, general history, psychology, sociology, civics, economics, etc.

SHORT WINTER COURSES.

During a portion of the winter term, practical instruction is given in matters directly related to farming, stock raising and fruit growing, and the management of steam engines, with special attention to machinery used on farms. Any person over sixteen years of age may take this work, no examination for admission being required. A circular describing the work of these courses in detail will be issued in November. In 1902 they will cover eight weeks, from January 7 to February 28. The following list contains the work which will be given at that time:

Breeds and Breeding of Live Stock—18 lectures.
Diseases of Live Stock—18 lectures.
Stock Feeding—12 lectures.
Farm Dairying—9 lectures.
Crops for Oklahoma—18 lectures.
Farm Machinery and Equipment—18 lectures.
Steam Engines and Boilers—8 lectures.
Maintenance of Soil Fertility—9 lectures.
Orchards and Small Fruits—18 lectures.
Troublessome Insects—9 lectures.
Elementary Botany—9 lectures.
Farm Hygene; Water Supply —10 lectures.
Legislation and Laws Affecting Farmers—12 lectures.
Farm Accounts ,Mortgages, etc.—12 lectures.

Work in blacksmithing, steam engines and boilers, veterinary practice, and practical horticulture will be given in the afternoon in so far as the facilities of the college will allow.

The lectures will be supplemented by practical work in the

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dairy, barns, shops, and orchards, designed to fix and illustrate the methods and practices advised. It is practical instruction throughout and planned to give the most that is possible in so short a time.

OTHER SPECIAL COURSES.

The college also offers instruction in stenography, typewriting, and printing.

ADMISSION TO THE COLLEGE.

To enter the freshman class the applicant, under the territorial law, must be at least 14 years of age, and must pass a satisfactory examination in the following subjects: Reading, spelling, penmanship, geography, United States History, grammar, and arithmetic. It is urgently recommended also, that he be well prepared in physical geography and civil government, as these subjects are covered in our preparatory department.

PREPARATORY DEPARTMENT.

In order to meet the wants of those whose school facilities have not been sufficient to prepare them for the collegiate work, a preparatory or sub-collegiate course, extending through two years, has been provided, which gives a thorough and approved training in all the branches above mentioned, and in civil government, physical geography, and free-hand drawing. The age limitation for entrance to the freshman class (fourteen years) applies also to the applicant to enter the preparatory department.

EXPENSES.

Tuition is free. An incidental fee of one dollar per term is charged students entering from Oklahoma and Indian Territories. A fee of five dollars per term is charged students under twenty-one years of age entering from elsewhere. Text books are sparingly used, and will cost from $2.00 to $4.00 per term. Special students in stenography and typewriting are charged $2.00 per term for use of typewriter. A deposit of $2.00 per term is required of all students in the Sophomore class in chemistry to cover laboratory breakage.

OPENING.

Entrance examinations for the fall term, 1901, occur September 9-10. Fall term begins September 11. For catalogue and full information address

A. C. SCOTT, President,
Stillwater, Okla.

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REPORT OF DIRECTOR.

No change has been made in the main lines of inquiry conducted by the station since the last annual report was issued. The work is still confined chiefly to the study of questions having a bearing on animal production and of matters affecting the successful and profitable production of orchard and small fruits. The station is rapidly accumulating information which enables it to be of service to the farmers of Oklahoma, without at all neglecting the rigid requirements of thorough scientific work.

SUBJECTS OF INVESTIGATION.

Considerable attention is still being given to the wheat crop, both on account of its importance as a crop and because of the pasture which it furnishes during the winter months. Comparisons of early, medium, and late plowing and seeding and of a small list of varieties are being continued. The yield of pasture from wheat sown for grain and also for pasture alone is being studied.

Continuous cropping experiments with wheat and Kafir and with two rotations are being continued after the following general plan:

Eighteen one-half acre plats along the west line west of the barns and pond are set apart for these experiments. Plats are marked by permanent iron stakes driven into the ground below depth of plowing, with wooden stakes on top of these.

The general plan of the plats is as follows:

Plat 1,—Continuous wheat, manured when advisable, determined by yields.

Plat 2,—Continuous wheat, not manured.

Plat 3,—Rotation; corn, oats, wheat and cowpeas, 3 years, not manured.

Plat 4,—Rotation; corn, oats, wheat and cowpeas, 3 years, manured.

Plat 5,—Rotation; duplicate of plat 3.

Plat 6,—Rotation; duplicate of plat 4.

Plat 7,—Used for crops not growing on any other plats during a given season.

Plat 8,—Uneven land, used for grass trials.

Plat 9,—Continuous Kafir corn, manured.

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Plat 10,—Continuous Kafir corn, not manured.

Plat 11,—Rotation; castor beans, Kafir corn, cotton, oats, wheat and soy beans, 5 years, not manured.

Plat 12,—Rotation, same as plat 11, except manured.

Plat 13, Rotation; duplicate of plat 11.

Plat 14,—Rotation; duplicate of plat 12.

Plat 15,—Duplicate of plat 9.

Plat 16,—Duplicate of plat 10.

Plats 17 & 18,—Used for crops not growing on any other plats during a given season.

Moisture determinations are made on each plat as often as conditions require, sampling being done by the agricultural department and determinations by the chemical department.

The work with annual forage crops and trials of grasses continue to receive the attention which their importance demands. The improvement of native grass pastures by the introduction of other grasses is also being studied on a practical scale.

Feeding experiments with steers using Kafir corn, corn meal, alfalfa hay, and Kafir stover for fattening have been repeated. A summary of this work will be found elsewhere in this report and after another repetition, it will be published in full. Complete chemical control of the feeding trials was maintained last winter, all of the feed and refused feed being weighed, sampled, and analyzed. Chemical studies of the influence of the character of the roughage on the digestion of the grain ration are also being made. The study of the cost of carrying yearlings through the season and their gains during the winter and on summer pasture is being continued.

Experiments in pig feeding have been continued. A summary of this work is published in this report, thus making it unnecessary to describe it here. Experiments with chickens under average farm conditions are being continued, and a small flock of ducks has been added for a similar purpose.

The investigation of blackleg among cattle and the efficacy of vaccination as a means of prevention has been continued. A detailed report of this work will be found on another page. Extended studies of hog cholera and swine plague have been undertaken and are being continued. Contagious abortion is also being studied and the work with animal parasites has been continued.

Studies of a very destructive root-rot of fruit trees have been conducted and the results published. Much attention has been given

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to the study of insects affecting wheat, particularly the wheat louse described in the summary of press bulletins on another page.

An experiment in plant-breeding with castor beans, having in view the desirability of increasing the oil content and general productiveness of the sorts cultivated here, has been undertaken. A plat covering over a quarter of an acre has been planted to thirty six varieties of castor beans and it is the plan to secure as many crosses as possible between these sorts and the common castor bean of this region. The percentage of oil in seeds of the various sorts planted is now being determined and will give a basis on which to plan the crosses.

A plan of general co-operation with persons in different sections of the teritory in the study of plants, insects, and fungus diseases is being formulated with promise of valuable assistance in the work of the station.

The work with varieties and methods of cultivating fruits is being continued and its usefulness further extended by correspondence with successful orchardists. The work in forestry, especially as regards the cheap and rapid production of material for fence posts and fuel, has developed satisfactorily and already results have been secured which serve to indicate the most desirable trees to be planted and the methods which should be followed in this territory.

On account of its importance and the peculiar difficulties which are presented, the potato crop is receiving a large share of attention. Beside experiments with varieties and methods on the station farm and on bottom land nearby, methods followed in the potato growing district in the southeastern part of the territory are being studied. It is hoped that sufficient material will have been collected to make it possible to issue a bulletin on this subject before the time of planting the next crop.

While the foregoing constitutes the chief work of the station, there is of necessity much miscellaneous work which need not be detailed here, yet which is of great impertance in making the station's work effective. The constant effort is, however, to adhere closely to the true purpose of the station and to conduct the work along the lines that have been determined upon, after careful consideration, as being the most important and far-reaching for the agricultural interests of the territory.

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BULLETINS ISSUED.

The following bulletins have been issued during the year and are still available to those requesting them.

No. 47, September, 1900.

Reports of Wheat Raisers, by John Fields.

A summary of the reports of one hundred and eighteen farmers representing eighteen counties.

Experiments with Wheat, by F. C. Burtis and J. G. Kerr.

A report of the results of experiments with wheat on the station farm during the season of 1900.

No. 48, December, 1900.

Crop and Forage Notes, 1900, by F. C. Burtis.

A progress report on crops under test at the experiment station, principally relating to suitable varieties, soils, and the most desirable methods of cultivation.

No. 49, February, 1901.

A Rhizomorphic Root-rot of Fruit Trees, by E. Mead Wilcox.

A technical summary of the results of an investigation of the root-rot which is causing much loss to orchardists in many parts of the territory.

No. 49, (popular edition) February, 1901.

A Root-rot of Fruit Trees, by E. Mead Wilcox and O. M. Morris.

A popular summary of the results reported in the technical bulletin of the same number

No. 50, April, 1901.

Manuring the Soil, by John Fields.

A popular summary of the considerations affecting the use of manure on Oklahoma soils.

In addition to these, Press bulletins No. 62 to 73 have been issued and sent to the newspapers of the territory and to an extensive list published in other states. The newspapers circulating in the territory have continued to give wide publicity to the work of the station and have extended its usefulness to an extent that would not have been otherwise possible. Frequent press notices have been furnished in addition to the press bulletins whenever the need for them arose.

BUILDINGS.

During the year, a piggery and implement shed have been constructed and also propagating pits with work room attached. The

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veterinary laboratory in the new library building has been completed and affords excellent facilities. Within another year, the departments of botany and entomology will be comfortably housed in an addition to the library building, and the construction of a barn will greatly facilitate the work in feeding.

MAILING LIST.

Additions to the mailing list have been so frequent that it is necessary to print 20,000 copies of this report, of which about 18,500 will be sent to names already on the list and the remainder reserved to supply requests.

CORRESPONDENCE.

The correspondence of the station has greatly increased, there having been sent out during the year about five thousand letters in reply to inquiries. In addition to this, many communications are answered by the sending of bulletins and reports treating of subjects about which inquiries were made. Requests for services in the way of analyses have been numerous. These have been complied with in so far as qualitative examinations were concerned. The necessary expense of making quanitative determinations for individuals is charged in all cases.

Acknowledgement is due the many correspondents who have aided the work of the station by reporting along special lines, sending information in reply to requests, and in every way making the station's work of greater usefulness to their respective communities. It is only by extensive correspondence that the station can keep in touch with the problems that are confronting the farmers generally and determine lines of work that will be of greatest value to the agriculture of the territory.

FARMERS' INSTITUTES.

The work of farmers' institutes have not been thoroughly satisfactory because of lack of organization. The station has rendered assistance at five institutes during the past year and in each case, satisfactory meetings were held. A special trip, however, was necessary for each institute thus making the expense much greater than it should have been and than it would have been if some definite system of organization were in existence. The station can do nothing further than render assistance and can do this only to a

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limited extent. Institutes desiring aid in the way of speakers should give notice to that effect as long ahead of time as possible so that arrangements may be made.

THE STAFF.

There have been few changes in the personnel of the station staff during the year. Mr. A. G. Ford, assistant chemist, resigned September 1, 1900, and Mr. A. B. McReynolds was appointed assistant in chemistry in his stead. Mr. J. G. Kerr, assistant in agriculture, resigned January 1, 1901, and the vacancy thus caused was filled by the appointment of Mr. J. S. Malone. The staff for the coming year will be the same as for the last six months of the year just closed.

To an unusual degree, all of the members of the station staff have worked for the advancement and up-building of the experiment station as a compact institution working perfectly in all of its parts for the attainment of the ends for which it was established. Each of the departments is intimately associated with the others in one or more lines of investigation and completed work is regarded as belonging to the institution rather than to a given individual or department. No difficulty has arisen as to who shall receive credit for published results, and experience has shown that this method places the station on a satisfactory working basis, enabling it to carry on a variety of work that would not otherwise be possible.

July 1, 1901. John Fields, Director.

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SUMMARY OF PRESS BULLETINS.

A press bulletin is sent out from the station on about the fifteenth of each month. These bulletins are sent only to newspapers and are intended to contain timely topics related to the work of the station and the agricultural interests of the territory. They are printed in many of the daily and weekly papers of the territory and in agricultural papers elsewhere. The station is under obligations to those editors who have assisted in this manner and hereby gratefully acknowledges it. Some of the articles contained in the bulletins may have a permanent value and are reprinted in this report for convenient reference. They are, of necessity, fragmentary and, in part, a repetition of matter contained in regular station bulletins.

WHEAT EXPERIMENTS.

In the locality of the Experiment Station, at Stillwater, Oklahoma, the season of 1899-1900 was quite favorable to a large wheat crop. Nothing but the failings of man prevented yields of 30 to 40 bushels per acre. July gave excellent opportunity for plowing, and August fair. September and the first 25 days in October were very dry and untilled, or poorly tilled, ground became very dry and hard; but early plowed and well-tilled land remained in fine condition, and conditions for seeding and growth on it were fair, even during the severest of the drouth. On other land wheat perished, or suffered severely. Heavy rains late in October and excellent conditions during November greatly helped all wheat and especially that on late plowing and late seeding, and brought out much wheat that otherwise would have perished in an ordinary season.

The winter and spring were very favorable and wheat improved as each month passed. May afforded the very best conditions,—cool and moist. Frequent rains and hot muggy weather early in June developed a big crop of rust, and while the early wheat was damaged but very little by this, late wheat was cut short over 25 per cent. Chinch bugs arrived in the usual number and multiplied, but were checked by the frequent rains, and no damage was done by them to speak of. Conditions for harvesting were fine.

With a few exceptions the wheat on the station farm was seeded the last half of September, and harvested from June 7th to

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13th. All plats were drilled and at the rate of one and a half bushels per acre. Some of the wheat ground was manured and some was not. The farm is upland, about average in quality. Most of the experiments were on quarter to half acre plats.

The following are briefs from the coming wheat bulletin on the crop of 1899-1900.

WHEAT CONTINUOUS, WITH OR WITHOUT MANURE.

Plat 1, that had been continuously cropped to wheat since 1893, and had received a good coat of stable manure in 1898 and 1899, yielded in comparison with plat 2, cropped the same, but without manure, as follows:

TREATMENT	1899-1900 Yield Per Acre		1898-1899 Yield Per Acre	
	Grain, Bu.	Straw, Tons	Grain, Bu.	Straw Tons
Plat 1, manured	36.8	2.50	30.6	2.76
Plat 2, not manured	18.1	1.16	12.	1.37

For the past season the wheat from Plat 1 tested 60½ lbs. per bushel, as it came from the thrasher; Plat 2, 57½ lbs. per bushel, and the former was fine plump grain while the latter was more or less shrivelled. All through the season a great difference could be seen between the wheat on the manured and unmanured ground. On the manured ground the growth was better and the plants tillered much more and ripened five days earlier than that on the unmanured ground.

The virgin soil for plats 1 and 2 was broken in 1892 and up to 1897 they were cropped with wheat as one plat and contained one acre and the yields were as follows: 1893, 10½ bu., 1894, 20.9 bu., 1895, total failure; 1896, 7.1 bu., in 1897 plat 2 yielded 22.7 bu. per. acre, in 1898, 7.5 bu. Plat 1 practically the same for 1897 and 1898

EARLY, MEDIUM AND LATE PLOWING.

Wheat on ground plowed July 19, Aug. 15, Sep. 11, yielded as follows:

	Yield Per Acre		
	Grain, Bu.	Straw, Tons	Test, Per Bu.
Early plowing	31.22	1.81	60
Medium plowing	23.48	1.23	58½
Late plowing	15.30	1.00	53

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All plats were seeded with Red Russian wheat on September 15th at the rate of 1½ bushels per acre.

The ground plowed very fine in July and fairly well in August but with greatest difficulty in September; plowing up in great hard lumps that were broken up with much extra labor. Immediately after plowing and at frequent intervals the early and medium plowings were harrowed and at the time of seeding were in fine tilth and contained moisture enough to start the wheat at once, while on the late plowing the ground was perfectly dry and lumpy. A rain of .62 of an inch on Sept. 17 greatly aided the conditions on the early and medium plowing, but was a damage to the late, as it was only enough to start some of the wheat to growing and this was left to perish as the ground completely dried out in a couple of weeks, while on the early and medium plowing it remained in good condition. The late plowing headed a week later than the other, but the rust made it ready to cut at the same time. The test per bushel showed very well the difference in the quality of the grain. Not a great deal of difference could be seen between the wheat on the early and late plowing, but that on the late was thinner, weaker and more backward, and it was due to the very favorable season that it made the wheat it did.

The foregoing results with the ones obtained in former years emphasize again the great importance of plowing wheat ground early and working it well after plowing.

EARLY, MEDIUM AND LATE SEEDING.

This experiment was situated on ground that was manured the winter of 1898-1899. Wheat seeded September 15, October 15 and November 15, yielded as follows:

	Yield Per Acre		
	Grain, Bu.	Straw, Tons	Test
Early seeding	36.79	1.89	59
Medium seeding	34.84	1.98	58
Late seeding	23.47	1.82	48

The land was all prepared at the same time, and seeded at the same rate with Red Russian wheat. The ground was in good tilth at time of seeding and the wheat was very little retarded by drouth. The conditions both fall and spring were favorable for the late seeding, and while the stand was thinner and growth not as rank as the early or the medium planting, it was much better than

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could generally be expected on November seeding. The late seeding headed nine days later than the early but was cut short by rust and was ready to cut about the same time. If rust had not struck it, it would probably have yielded 10 bushels more per acre. These results agree very well with those of previous years at this station, only that those of late seedings are better than usual. Seeding should be done not later than the middle of October and better results will be obtained from seeding from the middle to the last of September.

VARIETIES.

The standard varieties of wheat that have been grown on the station farm for a series of years gave excellent results this year. There were but a slight variations in the yield per acre of the different varieties. The highest yield, 44.52 bushels per acre, was obtained from Sibley's New Golden, the lowest yield, 37.70 bushels per acre from Big English. The following varieties gave 42 bushels or over: German Emperor, Turkey, Pickaway; the following 40 bushels and under 42: Red Russian, Early Ripe, Fulcaster, New Red Wonder; the following 38 bushels and under 40 bushels: Fultz, Missouri Blue Stem and Early Red Clawson.

All of these are classed as medium early and there was but a few days difference in the time of the heading and ripening of the different varieties. Results from some six years tests at this station demonstrate all of these to be good standard varieties, and so far, from our work with newly introduced varieties we can find none better. The seed is all kept up to a high standard by careful selection and grading each year. If more fanning mills were used on our farms in preparing seed wheat there would not be so much call for new varieties. (July, 1900.)

WHEAT RAISING.

Successful wheat raisers in the different counties of Oklahoma have furnished the results of their experience to the Experiment Station at Stillwater. When all the reports are received, a bulletin will be issued giving the results.

This brief report is issued so that the results of the investigation, in so far as completed, may be made public in time to be of service this season.

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The reports are grouped by counties and have been singularly uniform for each locality, though differing in separated districts. The report for each county represents the condensed experience of all reporting.

With marked unanimity all agree upon the following points:

1. Plow early and deep, in July if possible, and work the soil well before seeding.

2. Seed early, usually in September.

This applies to all sections of the territory.

Hard wheats, as a rule, are preferred in the western half of the territory, and soft wheats in the eastern. The reports indicate that both hard and soft wheat have been tried with the result given above.

Below will be found a brief summary of the reports by counties.

CANADIAN.

The hard wheats are generally preferred. Varieties grown are Turkey, May, Mediterranean, Fultz, White Russian and Fulcaster. Preference was expressed in all cases for early plowing and early sowing. The average yields reported varied from fifteen to twenty-five bushels per acre. The amount of seed varied from three pecks to one bushel per acre. Rust has caused some damage but not to any great extent.

CLEVELAND.

Fulcaster wheat is considered best. Varieties grown are Fulcaster, Fultz, May and Mediterranean. Preference was expressed in all cases for early plowing and early or medium early seeding. The average yields reported are from fifteen to thirty bushels per acre. The amount of seed sown varied from one to one and a half bushels per acre. Small losses have resulted from rust and chinch bugs.

CUSTER.

Hard wheats are preferred. The varieties grown are Turkey, Mediterranean and Fultz. Early plowing and early seeding are advised, using from three pecks to one bushel of seed per acre. Rust

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and chinch bugs have caused some trouble. Yields reported vary from fifteen to thirty bushels per acre.

GARFIELD.

Hard wheats are preferred, White Russian, Turkey and Golden Chaff being grown. Early and deep plowing and medium early seeding are practiced, using three pecks to a bushel of seed per acre. Yields reported vary from fifteen to twenty-five bushels per acre, with small loss from rust and chinch bugs.

GRANT.

Hard wheats are preferred, the varieties grown being White Russian, Turkey, Oregon May and Fultz. Early plowing and early seeding are advised by all, the amount of seed being one to one and a fourth bushels per acre. The yields have varied from eighteen to thirty bushels per acre with small loss from fungus diseases and insects.

KAY.

The varieties known as Big May, Oregon Red, Fultz and Red Russian are reported as being desirable. As elsewhere, early plowing and seeding give best results. There have been small losses from chinch bugs, but the yields are reported at from twenty to thirty eight bushels per acre.

KINGFISHER.

Fulcaster, May, Turkey and Oregon May are grown. Turkey is regarded as the best hard wheat and Oregon May as the best soft. Early plowing and medium early sowing are advised. One bushel of wheat to the acre is sown, the yields averaging about twenty bushels to the acre. Rust has caused some loss on late sowing and plowing.

LOGAN.

Fultz, Fulcaster, Golden Chaff, Red Russian, May, Turkey, Walker, Gold Drop and Blue Stem Mediterranean are preferred. Uniformly, early plowing and sowing is advised and stress is laid on the desirability of thorough preparation of the seed bed before sowing. The yields are reported as averaging from eighteen to thirty-five bushels per acre. Losses from rust and chinch bugs have been very slight. One to one and a half bushels of seed is sown per acre.

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NOBLE.

Red Russian, Mammoth Red, and Big May are grown, giving yields varying from sixteen to thirty-two bushels per acre. Plowing early and deep as possible and early sowing is followed, using from one to two bushels of seed per acre, depending on size of berry. Very little loss has been caused by insects and fungus diseases.

OKLAHOMA.

The Fulcaster variety is placed first with Fultz a close second. Turkey is also grown to some extent. As elsewhere, early plowing and early sowing have proven profitable, and thorough working of the soil before sowing has given increased returns. Yields have averaged from fifteen to thirty bushels, from one to one and a half bushels of seed to the acre being sown. Losses from insects and fungus diseases have been slight.

PAYNE.

Oregon Red, Fultz, Egyptian Amber, Red Russian and Fulcaster are grown successfully. Early plowing and sowing is advised, using one to one and a half bushels of seed to the acre. Yields reported average twenty bushels to the acre with some loss caused by chinch bugs and rust.

PAWNEE.

Oregon Red, Fultz and Fulcaster are grown, the first being preferred. Losses from chinch bugs have been light and yields averaging twenty bushels to the acre have been secured. Early plowing and seeding are recommended.

POTTAWATOMIE.

Fultz, Fulcaster, Red Russian, May and Turkey are grown, the first three being preferred. Manuring is reported as being very profitable, and early plowing and sowing is followed. One to one and a half bushels of seed are sown. Small losses have been occasioned by rust and chinch bugs.

WOODS.

Turkey wheat is thought best in this county, the yields varying from fifteen to forty bushels per acre. Early plowing and seeding is advised and losses from fungus diseases and insects have been light.

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OSAGE NATION.

Fultz, and Fulcaster are grown, the former being preferred. The average yields have been about eighteen bushels per acre. Rust has occasioned small loss and no trouble has been experienced with insects. Early plowing and early sowing give best returns. (July, 1900.)

THE WHEAT CROP.

Oklahoma wheat growers suffer considerable loss because of the length of time which wheat must stand in shock before thrashing can be done. This loss could be almost entirely prevented if all of the wheat were stacked as soon after cutting as it becomes thoroughly dry. The extra expense is small, the quality of the wheat is improved and the wheat grower is then in a measure independent of the promises of the thrasher. The amount of wheat that is stacked is increasing each year and it is a move in the right direction.

The removal of the crop from the field makes it possible to prepare for future crops to better advantage. If the next crop is to be wheat, plowing may be done early in July and the soil placed in shape to take in and retain moisture for the next crop. If it is not possible to plow all of the stubble early that is to be put in wheat, a thorough disking will kill off the weeds, loosen up the surface, hold the moisture, and make plowing all the easier when time is found to do it. Some wheat is put in without plowing the stubble at all, either merely disking it and drilling in the seed or seeding with a disk drill. While an occasional good yield may be secured by this plan, it is the poorest sort of farming. In the average season, plowing will be many times repaid by the increase in the yield and at all times, thorough cultivation has a tendency to decrease losses from insects.

The soil of the experiment station farm at Stillwater is no better than the average wheat soils of the territory and certainly not as good as many, yet losses from insects are hardly noticeable and the yields are always well up with the highest. It is largely a matter of good cultivation that brings this about. While it is true that it is entirely possible to put in more work on a soil than an increase in the crop is worth, it is equally true that in many cases, the same amount of work put on one-half the present area would re-

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sult in an increased yield which would bring the total up to the present amount. Differences in soil and conditions are so great that each wheat grower must work these things out for himself and do the best he can, always striving for improvement.

The planting of cowpeas in wheat stubble is a profitable investment where pasture during the late summer and fall months is needed. This is best done when wheat is to be followed by some other crop. Cowpeas planted in rows thirty inches apart drilled so that there is one plant every two to five inches require about a bushel of seed per acre, and with one cultivation, yield an abundance of pasture in the average season. Soy beans planted in the same manner are also a valuable crop. The residue of these crops when plowed under improves the soil in much the same manner as plowing under a crop of clover does where it is grown successfully.

Selection of seed is of great importance. In general, the varieties generally grown in Oklahoma are good and if reasonable care is used in seed selection, the average standard will improve rather than deteriorate. While under some conditions, almost any kind of seed will produce a crop, it is in the trying seasons that the influence of good, sound, plump seed is shown.

A bulletin reporting the trials with wheat at the experiment station at Stillwater will be sent to all newspapers of the territory as soon as thrashing is completed but no regular bulletin will be issued, the general phases of the crop having been fully discussed in Bulletin No. 47 which will be sent to all who apply for it. (June, 1901.)

CROP AND FORAGE NOTES.

The following is a summary of the contents of Bulletin No. 48 which will soon be issued from the experiment station at Stillwater. The publications of the station are sent free to all citizens of Oklahoma who request them.

For the season of 1900, the spring rainfall was normal, the summer rainfall unusually light and not well distributed, and that of the fall was normal, but quite heavy in September. The temperature for the season was about the average, with the exception of an unusually low average during May. No hot winds occurred.

Conditions were not favorable for starting grasses. Bermuda grass and large water-grass were the only ones that survived the effects of crab-grass and August drouth.

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Spring seedings of alfalfa failed after having made a good start. Alfalfa on the station farm, where the soil is from four to twelve inches deep underlaid by a stiff, imperious sub-soil, has given very small yields and died out after three to five years.

Clover has proven very uncertain for this region, but at times, a fair crop may be harvested.

Corn suffered materially from drouth and the yield was about half a crop. Kafir corn yields were about double those of corn.

The spring was quite unfavorable for cotton and the stand was poor. The fine growth made late in the season, however, brought the yields well up toward the average of our best seasons.

The rape plant and field peas gave profitable returns as pasture crops. Cowpeas sown on wheat or oats stubble also furnish valuable pasture and hay. (January, 1901.)

MANURING SOIL.

A bulletin treating of methods of manuring the soil has just been issued by the experiment station.

The following is a summary of the bulletin:

Without going into detail as to the various considerations that may affect the results of manuring, at the present stage of our agricultural practice, the chief points to be observed are:

1,—To manure the soil. Use all the manure produced, prevent losses by washing away, quit burning straw, haul the manure onto the fields somewhere, sometime, somehow.

2,—Manure the highest and poorest spots, give a good application at one time—from fifteen to twenty two-horse loads—and manure another place next time.

3,—Manure with reference to the time of rainfall, to the next crop which is to be grown, and to the other work which must be done. Late fall and winter, when other work is not pressing, is a good time. Light top-dressings may be applied to wheat in the fall.

4,—Growing crops for green manuring alone is not the most profitable method. Pasture them and plow under the remainder when about mature. This applies chiefly to cowpeas. If sorghum is to be plowed under, it should be while the stalks are green and juicy so that they will decay quickly.

This bulletin and other publications of the Station will be sent to all who request them. (May, 1901.)

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SUGAR BEETS.

The experiment station has closed another season's work with sugar beets and the results have been strikingly uniform with those of previous years. The average of all results showed eight per cent of sugar in the juice with 69.7 as the co-efficient of purity. As the lowest standard for successful sugar manufacture is twelve per cent of sugar with a co-efficient of purity of eighty, it is very discouraging for the industry here. The average yield per acre was eleven tons and the experimenters had some excellent cow fed as a result. (November, 1900.)

YELLOW COTTON.

Considerable yellow, or Nankeen cotton has come into the market this season. This is a most undesirable variety and sells for a cent and a half less than white cotton. Cotton growers should select their seed and strive to secure only good, white cotton, with long staple and a tendency toward early maturity. (December, 1900.)

EXPERIMENTS IN CATTLE FEEDING.

The Oklahoma experiment station is continuing its feeding experiments with hogs and steers. Last winter a bunch of twenty steers were fed, using corn and Kafir meals and alfalfa hay and Kafir stover in such a manner that the relative value of each for the production of beef could be determined. The same work will be duplicated this winter in order that as many trials as possible may be made before definite conclusions are drawn. Last year's results were reported in the annual report of the station. They pointed out the great value of alfalfa when fed in connection with either corn or Kafir meal and also showed that it is possible to fatten steers on Kafir meal and Kafir stover, though not so economically as when corn meal and alfalfa are used.

The feeding experiments with hogs will be chiefly along the line of determining what amount of cottonseed meal may be fed with safety to hogs. Last winter's results were very encouraging, a number of hogs being fattened with cottonseed meal with the loss of but one hog, and that due to intentional feeding of the meal after the danger point had been reached. The feeding of cowpea and alfalfa hay to hogs will also be continued, previous trials having indicated the great economy of this practice. (October, 1900.)

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COTTONSEED AND COTTONSEED MEAL.

At the present prices that are prevailing for cottonseed and cottonseed meal, the latter is the cheaper and better feed. Every grower of cotton should also be something of a stockman since he is producing one of the very best of stock foods and should utilize it at home so as to keep up the fertility of the soil. Just when to feed cottonseed and when to feed cottonseed meal is a question which troubles many farmers. In so far as the feeding value goes, it is true for all practical purposes that when what is received for a ton of cottonseed will pay for seven hundred and fifty pounds of meal, it is economy to buy meal. At the present prices it will do more than that and no cottonseed should be fed this fall.

The addition of about two pounds of cottonseed meal per day to the ration of corn or Kafir meal usually fed to steers that are being fattened is profitable, especially when corn or Kafir stover is used for roughness. The cottonseed meal supplies the flesh and growth-making materials which corn and Kafir corn lack and produces better growth and more rapid gains. It is better for this purpose than cottonseed because the oil which is taken out at the mill is not needed in the feed of cattle that are being fed on corn or Kafir. If the stockmen and diarymen of the northern and eastern states can afford to pay high freight and still use cottonseed meal as feed for their cattle, it would certainly be profitable for Oklahoma farmers to make use of all that is grown here and keep our fertility at home. Every ton of cottonseed meal is worth what it costs as a fertilizer and when fed to cattle, all this fertility is kept at home where it belongs. (October, 1900.)

PASTURE CROPS FOR HOGS.

Pasture and range are necessary in order to keep breeding swine in a healthy condition and grow the stock at a profit. The man who tries to raise swine under other conditions is playing a losing game, and his balance will be on the debtor side of the ledger just as sure as we have day and night. Although these facts have been vouched for many times by experiment stations and successful swine raisers and given wide publicity, thousands of farmers still continue in trying to raise hogs in a dry lot with nothing but corn as a feed, with the expectations of making it a profitable operation.

A hog pasture does not mean a dust lot with possibly a few

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old weeds off in one corner, but a good and commodious range, and if planned to give the best results, it will contain a variety of crops, selected as to their food value. The pasture should not be so small that the hog is compelled to eat his own filth to get the feed. Every farm should have six to eight acres of hog pasture fenced purposely for this use. This is in addition to what range may be utilized outside at times. Better far to have a little too much than not enough. If the crop gets ahead of the hogs and becomes woody cut it off with the mower and a new growth will start. This can be done with many plants and will pay even if the mowed portion is not gathered. The pasture may be greatly fertilized by this method in many cases. The enclosure should be divided into two or three parts, at least, so that while one part is being pastured, crops may be growing in the others.

While succulent food is very essential the year round for growing and breeding stock, the exercise is just as necessary. Pigs confined in pens will do much better if they have some green feed, but the results will be vastly better if the pigs are allowed a range and the chance to gather this feed for themselves.

Any green crop is much better than no pasture, but some crops for this purpose are very much superior to others, and a variety of crops, even though they may be much alike in composition, are superior to a single crop. Many swine raisers that appreciate the value of a hog pasture do not realize the importance of giving attention to variety and composition of the plants to be used.

In selecting the crops for a hog pasture consider the composition of the plants as you would consider the composition of the grain in a ration. Bear in mind that certain crops are rich in the food nutrient protein, that is so essential in the animal system to build up the frame and muscles, and is very necessary in the food of breeding stock. Crops of the opposite nature are rich in carbohydrates, the heat and fat forming compounds.

Endeavor to have some of the former to pasture along with latter and the results will be better. Plants belonging to the former group, those that are especially rich in protein, are alfalfa, clover, field peas, cowpeas, soy beans, vetches and peanuts. Rape, sorghum, the cereals, sweet potatoes, and artichokes belong to the opposite group. Aside from being especially valuable for food, the cowpea group adds greatly to the fertility of the soil while growing on it, and will give paying yields on soil too poor for other crops.

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While a wheat pasture, or a sorghum pasture perhaps is of great value the results will be much more satisfactory if cowpeas or some like crop can be pastured at the same time.

In selecting the crops, due attention should be paid to the point of having a succession of crops that will furnish green feed at all times. Drouth resisting crops should be included for the drouthy time of year. Some crops with proper handling will furnish feed almost the year round while others are suitable for only one of the seasons, or a part of two.

In this list of crops for hog pasture, alfalfa, wheat, rye and oats will not be taken up in full.

Where alfalfa can be grown successfully, it has no equal as a pasture crop for hogs, and it furnishes a large amount of feed almost the year round when handled properly.

But about nine men in ten that use it for that purpose ruin it by too close pasturing and at improper times.

Wheat, oats and rye are standard crops for this purpose and may be so grown as to furnish green feed for almost the whole year. But many times they are over pastured and pastured too late when the crop is to be left for grain. In both of these cases other crops should be furnished to prevent the over-pasturing and at improper times.

In addition to the above named crops that may be utilized for this purpose, should be mentioned field peas, rape and vetches.

The field pea belongs to the cowpea class and is suitable to a cool, moist climate and will withstand a hard frost, so should be seeded early in March. Broadcast a bushel and a half of peas, plow under four or five inches and harrow down and then seed a bushel and a half of oats on top of this.

The peas are ready to pasture when they start to bloom. The seed costs from $1.50 to $2.00 per bushel which will keep many from growing them It is well to see if a more suitable crop is not available, but field peas are worthy of a trial in this country. The yield of oats and peas the past season on the station farm was 15 tons per acre. Fair results have been obtained from fall seeding on the station farm.

The rape plant makes the best of spring pasture. It is a plant that furnishes, under fairly favorable conditions, a large amount of green feed in a short time from planting. The color and texture of the leaves resemble cabbage, but it grows two or three feet tall and has no value only in the green stage. It is grown over a wide

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territory and under varying conditions but adapted to moist, cool weather and a good, rich soil. For a time it was thought suited only to the Northern states and Canada, but gradually it is working South and has given very favorable results in Oklahoma and should be tried by all hog and sheep raisers.

The following results were obtained on the station farm the past season.

	Tons per acre.
Rape, drilled, rows 30 inches	23.5
Rape, drilled, rows 6 inches	11.
Rape, drilled with oats	12.5

The seeding was made the last week in March and the yields determined June 2nd. The plots were on well-manured land.

For this country the seeding should be made early in March. The hot dry weather of August has stopped the growth here, and the June seeding for fall pasture as advised by some will give very uncertain results as will the seeding in corn just before the last cultivation. Such methods may give fair results at times of much rain fall. It is a plant that stands a great deal of cold and frost.

Seedings made on the station farm last fall have lived through the winter and the plants are making an early spring start. The fall growth was rather small. Both broadcasting and drilling for cultivation are practiced. For this country, if much dependence is put upon the crop, drilling in rows to admit of cultivation is recommended. Planted in this way it will stand the drouth much better and if pastured and cultivated properly, the period of growth may be greatly extended, and much more feed obtained. A good rich soil is more essential where broadcasting is employed.

For broadcasting, three to five lbs. of seed per acre should be used. For drilling in rows 30 inches apart, one or two pounds should suffice. The poorer the soil and the more unfavorable the conditions, the more seed necessary.

The plants reach their maximum growth in 6 to 10 weeks from seeding but pasturing may commence as soon as the plants are firmly rooted. Sheep or hogs do not like the plants at first, but by limiting their other feed, they will eat it, and when they have acquired a taste for it they eat it greedily. Care must be taken in turning sheep on it to avoid bloating. There will be several successive growths if the plants are not pastured or cut closer than 4 inches from the ground. The seed costs about 10 cents per lb. in small quantities. The Dwarf Essex variety should be used.

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Rape and field peas, and rape and oats make fair mixtures for seeding.

The following may be considered summer and fall pastures: Sorghum, cowpeas, peanuts, sweet potatoes and artichokes.

Sorghum is the most reliable and largest producer of pasture for summer. While it furnishes a large amount of green feed per acre, it is highly carbonaceous, and should be pastured along with cowpeas for best results.

Its culture is well understood. Seedings may be made from spring to late summer. It will always be found a standby during drouths. While broadcasting is the common way of seeding for hog pasture, it is always advisable to drill and cultivate some as this will make better feed in a case of severe drouth. And when grown this way the sugar content is much greater and any stalks left will make good winter feed for hogs. In selecting the seed, the sugar bearing varieties should be chosen and seeded thinner on the ground than when the crop is grown for hay. Sorghum may be seeded with oats in the spring with good results. The sorghum continues after the oats are gone.

Cowpeas make a good twin brother to sorghum for hog pasture The peas furnish the nitrogenous material that the sorghum lacks. Cowpeas are great drouth resisters and admit of many ways of planting and over a large season. Seeded on ground from which a crop of oats or wheat have been removed, they will produce from 1½ to 2 feet of growth by the first of September. For earlier feed than this they should be seeded the last of April or the first of May.

While broadcasting is a very successful method of seeding them, it is very desirable to drill and cultivate some as this will aid them to withstand drouth, and more feed will be produced at a critical time. For broadcasting about 1 1-4 bushel of seed is required per acre; for drilling in rows 30 inches apart, three pecks.

Peanuts are a crop that do well in Oklahoma, and many are raised for market, but they have greater value to the territory for hog pasture. For hog pasture they can be made to pay on any soil that is open enough to work easily. The hogs harvest them and that expense and labor is saved. Many a peanut crop harvested and marketed at a loss would have yielded a handsome profit if it had been used as a hog pasture. Peanuts should be valued as a protein producer, and for that purpose are very valuable as they contain about 30 per cent of that most valuable food ingredient. While

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the vines are green they are eaten and afford valuable feed. The crop should be pastured along with sorghum, rye, wheat, or oats for the most profitable results. For hog pasture the crop can be grown as cheaply as corn. Plant as soon as all danger of frost is over. Have the soil in fine tilth. Make the rows two and a half or three feet apart and drop the seed twelve to sixteen inches apart in the row. About two bushels of the nuts in the pod will be required to seed an acre Give clean culture, and no hilling up is necessary. The Spanish variety is best suited for this purpose.

Sweet potatoes make a good feed for hog pasture. The expense of this crop is quite light up to the time of harvesting and the hogs will do this to perfection and give good returns for value received. The culture of the crop is well understood. It can be made ever profitable utilized as hog pasture.

Artichokes are a most excellent crop to furnish fall and winter pasture for hogs. Under proper treatment 400 to 800 bushels of tubers per acre may be counted on. Plow the ground as you would for potatoes; plant in April in rows three feet apart with the hills fourteen to eighteen inches apart in the row, and cultivate as you would corn. In this country the pasture is available the winter through. (March, 1901.)

BLACK-LEG VACCINE.

During the past six months the experiment station has been sending out vaccine for the prevention of black-leg in cattle. This vaccine is for free distribution to the farmers and stockmen of Oklahoma. The use of vaccine as a means of controlling black-leg among cattle is particularly urged because there is no means of curing the disease, while vaccination has proved very effective in preventing and controlling the disease.

All cattle under two years of age should be vaccinated but it is doubtful if the vaccination affords the protection to calves under six months of age that it does to older cattle. For this reason all calves vaccinated under six months of age should be vaccinated the second time before they are a year old. Cattle may be vaccinated at any season of the year and the owner should not wait until he has lost cattle before using the vaccine.

A letter to the experiment station will secure the amount of vaccine required and full directions for using it. (September, 1900.)

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HOG CHOLERA.

Several inquiries have reached the experiment station during the last month concerning swine diseases. One reported outbreak of hog cholera was investigated and a very extensive outbreak of the disease was found to exist among the hogs on two farms. At the time of the visit over 200 head of hogs had died from what proved on examination to be hog cholera. What the station especially desires is to correspond directly with all who are losing hogs from any disease and particularly with those losing hogs from any form of disease appearing to be contagious and spreading from one farm to another.

The best means of preventing the spread of the disease from an outbreak is to stop all communication between the pens and to burn every animal lost. Burning is much safer than burying as there is no danger of dogs carrying the disease by digging up the carcass and carrying pieces of flesh and bones to adjoining pens. If the disease exists among hogs having access to running water all hogs using water below that point should be immediately fenced away from the stream. In any case to allow a dead animal to decompose in a stream is a very careless thing to do and if the animal has died from a contagious disease the water is about the surest means of spreading the disease. (December, 1900.)

FRUIT TREES.

This is the season of the year when orders are being gven for nursery stock for fall planting and those about to set out an orchard should avail themselves of the experimence of those who have been engaged in frut growing in Oklahoma.

About a year ago, the experiment station collected and summarized the experience of successful fruit-growers. This summary, together with the results of trials at the station, was issued in the form of a bulletin entitled "Fruits for Oklahoma." Copies of this bulletin may be had by writing to the station.

In general, it pays to buy home-grown nursery stock and to disregard the blandishments of the man with something new and wonderful. The varieties mentioned below are reliable and preferred by many successful orchardists.

Apples: Mo. Pippin, Ben Davis, Winesap, Jonathan, Ark.

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Black, Maiden's Blush, Mammoth Black Twig, Cooper's Early White, and Yellow Transparent.

Peaches: Elberta, Alexander, Crawford's Late, Crawford's Early, Heath Cling, and Salaway.

Plums: Wild Goose, Abundance, Burbank, Wickson and Marianna.

Cherries: Early Richmond, English Morello, Montmorency, May Duke, Wood, Ostheim, and Olivet.

Good nursery stock is of first importance, but the character of the care which is given it after setting out determines the degree of success which will be attained. Continued clean cultivation and watchful care is necessary and will be abundantly repaid. (September, 1900.)

NEW AND REMARKABLE PLANTS.

Much money is wasted every year in the purchase of nursery stock that is "the greatest wonder of the age." People keep on buying this sort of things and probably will continue to do so. Some enterprising man, out of a job, perhaps, or possibly because there is money to be made at it, arranges with some grower of nursery stock to fill his orders with the cheapest sort of seedling apple trees. The agent starts out and names it "The everbearing pumpkin apple." Trees are sold for fifty cents or a dollar each, and the purchaser plants the "ever bearing pumpkin apple tree," watches it closely for four to six years, and at last there are a few blossoms. What delicious "pumpkin apples" will be his! When fall arrives, and a few little, sour apples are all that are secured, there is considerable disappointment, but usually further hopes for future development. If plain, reliable trees of Missouri Pippin, Ben Davis, Winesap, Johnathan, Arkansas Black, Maiden Blush, or any other standard varieties had been planted good fruit would have been secured instead of nothing.

This is but an illustration. The principle holds good in the purchase of seeds and plants of every sort. Purchasing seeds and plants from well-known nurserymen and seedsmen is the best and safest plan. Expectations of a great deal for nothing or of securing something unusually profitable will not be realized. Fruits are mentioned particularly because of the frequency of deception in tree-selling and of the ease with which profitable, thrifty, reliable, nursery stock may be secured. (February, 1901.)

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PLANT TREES FOR POSTS.

The planting of forest trees is of great importance in Oklahoma. There are few of the prairie farms but have one or two small pieces of land cut off from the pasture that are not easy to cultivate. A little time and work will fit most of those places for the planting. One or two years' cultivation will place the trees in condition to take care of themselves. The trees should be set in check rows about four feet apart, and cultivated the same as corn.

Seedling trees can be purchased from most of the large nurseries at three to five dollars per thousand. It is a good plan to cut off the entire top of the plant when setting out. This will give a good strong, straight growth for the trunk of the future tree. A little pruning during the first and second summer will start the trees with good clean trunk and after this but little care will be needed. A small plat of land if properly handled will in a few years furnish an abundance of fire wood and posts and poles that are necessary for fences. The value of a constant supply of timber on the farm can hardlly be over estimated.

The hedge fences are not to be recommended except in special cases. Posts can be grown in groves much cheaper than in line hedges. The labor required to keep a hedge fence in good shape would care for a large grove. A tall hedge may sometimes be of great value for a wind-break, and for such purposes their use should not be discouraged A grove will usually furnish better protection to other plantings and buildings.

The varieties best adapted to Oklahoma are Black Locust, Catalpa, and Osage Orange. The Soft Maple, Mulberry and several other kinds may succeed but cannot be strongly recommended. Black Locusts set on thin upland soil on the experiment station farm, in the spring of 1898, then one year from the seed, are now from twelve to eighteen feet high and two and one half to four and one half inches through the trunk. Catalpas the same age and set on the same land at the same time and age are about ten feet in height and two and one half inches in diameter. (December, 1900.)

PLANT SHADE TREES.

Trees add much to the comfort and beauty of the home, whether it be located in the city or in the country. Trees, if cultivated, grow rapidly in Oklahoma. They should be set out in large holes

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that have been filled in to the proper depth with good, rich soil. Elm, soft maple, black locust, catalpa, box elder, ash, mulberry, in the order named are desirable trees. Every planting should include some elms because they are long-lived and more permanent than the others mentioned. Continuous, shallow cultivation is necessary for success, and if this is neglected, failure is almost certain. (January, 1901.)

APPLE ROOT-ROT.

A disease commonly known as the apple root-rot is doing a great deal of damage to some orchards in Oklahoma. The disease first attacks the small roots and then spreads to the larger roots and trunk. The roots that are attacked die and decay very rapidly. The disease spreads rapidly along the roots and in about two years the entire root system of the tree is killed. Trees that were attacked in the summer of 1899 usually set a large crop of fruit in 1900. Many of the trees died before the fruit matured. If the trees are set deep the first symptoms are a lack of vigor and the yellow color of the leaves. The tree shows plainly the lack of food and moisture. If the tree is set shallow, dead leaves can be seen around the base of the trunk. Trees show a great tenacity of life and live for sometime when there are but a few live roots.

If the dead bark is examined thin layers of a white velvety substance can be seen between the layers of bark. In the thick bark around the base of the trunk this white material is very often conspicuous but can hardly be detected on the smaller roots. A mushroom is the cause of the disease. It seldom develops the fruit stalks and caps. The fruit stalks are sent up in thick clusters from the base of the trunk. The stalks are round, from one-eighth to one-fourth of an inch in diameter and about two inches high. The cap is about the shape of an inverted thimble and is from one-half to one inch in diameter. The stalks and caps of this mushroom are edible. As will be seen from the foregoing the tree is starved by having the food supply shut off.

This disease is not confined to any one variety or class of varieties. It attacks the cherry the same as the apple There is no connection between this disease and any form of grafting, budding or transplanting as there is commonly supposed to be. Neither is it confined to trees shipped from any definite locality or climate. It is

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however in so far as is known confined to orchards that were set out on land formerly covered with timber. The disease is on the roots of the forest trees and lives for several years on the decaying roots left in the ground. It spreads from the dead roots to the growing roots of the orchard trees. It has been found in Missouri, Texas, California, and Tennessee.

There is no known cure and the only preventive seems to be not to set the trees on infected land. One tree about five inches in diameter was very badly affected. The leaves were turning yellow and the tree showed little prospects of living until fall. On examination by the horticulturist of the experiment station three-fourths of the root system was dead and the disease spreading rapidly. The dead roots were removed and the dead wood and bark cut away. About fifteen pounds of fresh, unslacked lime was worked into the soil around the tree. This work was done on July 21. A light rain fell on July 20 and 21. The leaves ceased to turn yellow and fall and on October 1 the tree showed better foliage than in July.

Orchards should not be set on timber land for three or four years after all timber has been removed. Liming the soil may hold the disease in check but can not yet be recommended as a cure or preventive. (October, 1900.)

ROOT-ROT OF FRUIT TREES.

The Oklahoma Experiment Station has published a bulletin summarizing an investigation of a serious root-rot disease which is destroying many fruit trees in the orchards of the territory. The disease has been noticed in many localities and seems to be confined to lands that have been cleared of timber before planting to trees.

"The symptoms of this disease are so characteristic that no one should experience any great difficulty in correctly diagnosing any suspected cases. Perhaps the most characteristic effect of the attacks of this fungus is the great exudation of gum about and from the crown of the diseased trees. This flow of gum occurs in maple, peach and cherry trees and is reported for the apricot tree. It frequently happens that the amount of this gum to exude is so great that it unites with the soil about the base of the tree to such an extent as to form a mass of cemented soil about the tree. In

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many cases this mass of gum cemented soil will become hardened to form a sort of cast about the crown and larger roots of the tree.

The yellow coloration of the leaves is usually one of the prominent symptoms of the disease. In many cases however the leaves wilt rapidly during the growing season instead of becoming yellow. This rapid wilting of leaves is the first external evidence afforded that the root system of the tree and consequently its absorptive ability have been greatly reduced.

The groups of mushrooms found about the base of the trees will afford the most positive evidence of the presence of this disease. But unfortunately this evidence comes too late for the application of any remedial agent; for the mushrooms seldom appear about the crown of the tree until the disease has so far progressed that no preventive or remedial measures can be applied.

The fungus of this type is well provided with means to insure its rapid distribution throughout large orchards. The spores, that are produced in such large numbers, are easily scattered about and each one may, under proper conditions, give rise to a mycelium and the typical sporophores. Perhaps the beetles that are often seen eating the old pilei are of some value in distributing the spores, but this point needs some further investigation.

The most fertile source of infection is certainly found in the several sorts of mycelial strands produced by this fungus. The subcortial mycelium in an old stump or even a diseased tree may give rise to the purplish-black rhizomorphic strands and these will grow out in the soil to a considerable distance. In one case the author was able to trace these subterranean strands for a distance of about ten feet from a partially decayed oak stump. One of these same strands was followed, at an average depth under the surface of the soil of ten inches, for about eight feet where it was found entering the cortex of a living "Ben Davis" apple tree. None of the other roots of this tree were diseased and it was plain that the first entrance of the mycelium had been made at this point, out on one of the smaller roots at least six feet from the trunk of the tree.

Though the first entrance to the tree is generally made by the mycelium through the cortex of a small root, yet cases were found in which the mycelium had evidently entered the crown of the tree first and then spread out through the smaller roots and up into the trunk. As a rule the mycelium does not grow up in the trunk

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above three feet from the crown. In fact in many cases no trace of the mycelium can be detected in the trunk more than five or six inches above the crown.

The greater part of our knowledge concerning the proper remedial measures to be applied against this and other wood destroying fungi is derived from the wide experience of the foresters of Europe. Among the strictly remedial measures none are of greater importance than the isolation of diseased trees by ditching. If a single tree in the midst of the orchard is found to be diseased, a ditch should at once be dug around it to prevent if possible the further spread of the disease by the subterranean mycelial strands. This ditch should be dug at a distance of about ten feet from the tree, i. e., with a diameter of about twenty feet. The ditch should be about one foot wide and about two feet deep with vertical walls. The same measures are to be adopted to protect a group of diseased trees that are found in the orchard. In this case the ditch may be dug so as to include all the trees in the group. It is possible that the burning of brush in this ditch will kill the rhizomorphic strands and prevent further spreading. So far as the author is aware this method has never been practiced to any great extent in America though in Europe it seems to have proven effective in combating this and similar diseases.

It cannot too strongly be insisted upon that all fruit trees that are found to be diseased should at once be removed from the orchard. Care must be taken in such cases to remove and burn not only the trunk but all the larger roots and especially all those diseased. Perhaps a tree will bear saleable fruit after the mycelium of this fungus has entered its root system but it is a near sighted system and poor business to allow such a tree to stand when it is remembered that thereby all the other trees in the orchard are being endangered.

Too great care cannot be taken to avoid cutting or otherwise injuring the roots of the trees by plowing or other cultivation. Though the mycelium of this fungus is able to enter the cortex of perfectly healthy roots, yet its progress as well as its entrance, is greatly faciliated by wounds of any character. In one of the orchards visited last fall it was apparent that in some cases the mycelium of this fungus had first entered the roots through wounds made by the plow in cultivating between the rows.

Attention has frequently been called to a practice among some fruit growers of placing in the bottom of a hole, in which they are

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about to set a tree, a quantity of chips from their wood pile. In many of these chips there are sure to be found some of the mycelium of this fungus and the introduction of the disease into the orchard is the result of this practice in many cases. For it is a well known fact that each small piece of mycelium of this fungus is capable of remaining dormant for long periods and of again producing, when placed under proper conditions, the mycelium and even the normal sporophores of the species.

It was early found in these investigations that the disease was largely or entirely confined to those orchards that were planted on recently cleared timber land. In fact the disease has never been reported in this territory, from orchards planted out on real prairie soil. Subsequent investigations have afforded abundant proof that the fungus described in this bulletin is common as a parasite and also as a saprophyte on various species of oak in this territory.

Old oak stumps or even dead oak roots remaining in the soil are apt to become fertile sources of the infection of the healthy trees planted in that same soil. From the above it follows that it is the part of wisdom to remove all old oak stumps from the orchard and to dig up all roots of such trees remaining in the soil. These should be carefully burned and in no case allowed to remain on the surface of the soil.

From the nature of the disease the application of any fungicide as a remedial agent cannot be recommended at all. And there is much doubt if their application to the soil will effectually prevent the spread of the mycelium through the soil from diseased trees or stumps. This is made probable from the fact that these fungicides are apt to lose their effectiveness in the soil through chemical combination with other things present in the soil.

It is very doubtful if any great good will result from "liming" of the soil or from mixing a large amount of wood ashes with the soil. Neither of these methods would be of the slightest value as remedial methods and further tests must be made before any value is ascribed to them as preventives of the further spreading of the mycelium.

And though thorough cultivation of the soil is always to be recommended for other reasons yet this may not tend to greatly reduce the spread of this disease. The thorough cultivation of cleared timber land in other crops before planting an orchard is

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of course to be commended. Perhaps in this fashion the fungus may simply be cultivated out of existence.

In view of all that has been said it is plain that it is not advisable to replant trees in holes from which diseased ones have just been removed unless perfect precautionary measures have been taken to rid the soil of all traces of the mycelium. And it is even doubtful if new trees should ever be planted out between the rows of diseased ones.

And finally all sporophores that are found should be burned. The search for disease resisting varieties will probably prove a failure and is a method that has in similar cases not yet proven itself entirely practical. The fact that this fungus and other similar ones are found as parasites on such widely different species as noted above would of itself discourage the attempt to secure a disease resisting variety."

Orchardists who have lost trees because of this disease are requested to communicate the facts to the experiment station. (April, 1901.)

SOME IMPORTANT FRUIT DISEASES.

During a recent visit to some of the leading fruit-growing regions of Logan and Kingfisher counties, some interesting facts concerning some important fruit diseases were secured. Among these diseases none equal in importance the "black rot" of the grape which now threatens the grape industry in these regions. This black-rot makes its first appearance on the fruit as small brownish-black spots—these spots rapidly grow in size and become black. The grape finally shrivels up but remains attached to the stem. The "Niagara" seems to be most frequently attacked while the "Concord" is quite free from the disease in the vineyards visited. The "Dyze," a reddish sweet grape, and the "Golden Pocklington" are also somewhat diseased in certain vineyards.

The rapidly growing wine industry of Oklahoma makes it important that all grape diseases be carefully watched and controlled. This "black-rot" can easily be controlled by means of spraying with the usual Bordeaux mixture. The first application of this fungicide must be made before the vines begin their growth in the spring and should be followed at intervals of about ten days to two weeks for about three more sprayings. The last spraying may

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well be with the ammonical copper carbonate since this is not so apt to injure the fruit as is the Bordeaux mixture.

Another grape disease affecting the young shoots is now being studied with a view of securing some practical remedial or preventive treatment.

The apples and pears are suffering from the so-called "blight" in many of the orchards visited. This blight is caused by one of the parasitic bacteria which winters over in the young twigs. Early in the spring the germs make their escape and infect the flower buds and young leaves. The leaves rapidly turn black and the peculiar odor of rotten apples given off by the crushed leaves and young shoots is a characteristic easily noticed. These blighted shoots should be promptly removed and burned. In no case should they be allowed to remain on the trees or be removed and thrown on the ground about the trees. No spraying is effective in combating this dreaded "blight" but the suggestion just offered, if carefully and promptly followed, will eventually rid the orchard of this disease. (June, 1901.)

PROTECT BLACKBERRY BUSHES.

Many blackberry and raspberry vines in Oklahoma are going into winter quarters this year with large quantities of immature wood. The dry weather of July and August caused most of the vines to ripen the wood of the spring and summer's growth. The fall rains came early, while the weather was yet warm, and caused the vines to make new growth which can not be ripened before frost. The soil contains a good supply of moisture and if the vines can be protected from long dry freezing they will suffer but little during the winter. If the patch is on a south slope and protected from north winds it may be left to take care of itself. If the patch is not so favorably located a little time can be very profitably used in laying the plants down. This work should be done while the land is moist, not wet, and in good working order. All the old vines should be removed and the new ones thinned out and put in shape for next season's crop. Dig a ditch about 6 inches deep and 9 inches wide along one side of the row. This ditch should be close enough to the row to remove the soil from one side of the plants down to the roots. The vines can then be easily bent to the ground by placing a hay fork in the top and pushing them over into the

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ditch. Stick the fork into the ground to hold the vines firm until a little soil can be thrown on them. The vines should not be covered more than 2 or 3 inches deep. Some soil should be thrown into the ditch to keep the roots moist. If a very hard winter is anticipated the entire vines could be covered The vines may be fastened down with a wire or poles and covered with hay or straw. This method serves the purpose quite well, but gives a good hiding place for rabbits and mice which may do the vines considerable damage during the winter.

This work should be done in the latter part of November or early in December. The covering should be removed and the vines raised before growth starts in the spring. If the work is carefully done it will greatly reduce, if not entirely prevent, winter-killing and thus do much to insure a crop the coming season. (November, 1900.)

MULCH STRAWBERRIES NOW.

The strawberry plants that have lived through the summer, which was not an exceptionally hard one, have had a good fall and are well prepared for the winter. The effects of weeds and grass in the patch will never show more plainly than at this time of year. Patches that have had fair care and cultivation are in good condition and no pains should be spared to put them in good shape for the winter. The dry weather that comes in January and March is usually very destructive to weak vines. A long dry freeze will frequently destroy all prospects of a crop the following season. The patch should be mulched with hay or straw this fall while the soil is full of moisture. The mulch over the plants should be light so that they have light and air. If the mulch is too heavy the plants will smother and die. When growth starts in the spring the mulch must be removed from the rows but may be left in the spaces until the fruiting season has passed. In patches that have been mulched cultivation should begin in early spring. The value of a winter mulch can hardly be over estimated. At the experiment station it has almost regularly amounted to the difference between a fair crop and a total failure. November and December is the best time to apply the mulch. (November, 1900.)

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PRUNING GRAPE VINES.

Grape vines should be pruned in December. The vines are then entirely dormant and in good condition. The most tender varieties in the experiment station vineyard always remain in good condition until about the middle of January and even later if there is much rain during December and January. If these two months are dry these varieties suffer much earlier.

The vines continue giving off water after the leaves have fallen. The greater part of the winter killing is caused by the vines freezing without the proper supply of moisture. The roots take up water slowly in winter and cannot supply the entire plant during dry weather. If the pruning is done in late fall there will be but a small portion of the original top to use the sap supplied by the roots.

The pruning should not be done while the vines are frozen, for fear of breaking and splitting the remaining vines. Tender varieties should be pruned early and laid down and lightly covered with soil. (December, 1900.)

MARKETING SMALL FRUITS.

Berry growers should soon purchase their supply of berry boxes and baskets in which they expect to market their fruit the coming season. The tub or large bucket and quart cup are the packages that have been in most common use in the berry market in Oklahoma, but are giving away to neat wooden quart boxes and crates.

The cost of the boxes and crates is very small and it greatly improves the appearance of the fruit. The berries should be put in the baskets just as they are gathered. This prevents the necessity of further handling, crushing and soiling the fruit. It can then be delivered in better condition and is worth more in dollars and cents to the consumer. Berries that are placed in small baskets as fast as they are gathered will keep fresh much longer and will sell for a higher price than the berries that were of the same quality when gathered but have been handled in bulk. The increase in price of the berries will much more than pay for the boxes and crates. The ease with which crated berries can be sold is often of great importance especially in a full market.

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The claim is often made that fruit is so cheap that it will not pay for the boxes. This is sometimes true but the difference in price of the crated and uncrated berries is often the difference between a profit and a loss in favor of the crated fruit.

There are several kinds of boxes and crates used for small fruits any of which answers the purpose very well. A quart package is the most common size used for berries. These boxes are made of wood or paste-board and are always given with the fruit. The crates are made of wooden slats and usually hold 36 quart boxes. These can be used during the entire season when the berries are sold in the home market, but if shipped new boxes can be bought cheaper than the old ones can be returned.

The packages should be clean and bright and the packing done in good form It is often the package and the packing that sell the fruit as much as the merits of the fruit itself. (April, 1901.)

GARDEN NOTES.

The productiveness of the gardens of Oklahoma could be greatly increased by giving them a good application of barn-yard manure and turning it under this fall. The land should be stirred deep and well. This applies more directly to potatoes and root crops. On the experiment station farm the fall plowing has yielded from one fourth to one third more potatoes than spring plowing. The fall plowing has also yielded a large per cent of marketable potatoes. Land plowed before the fall rains have ceased is in much better condition than land plowed in winter.

All the old hay from the tops and bottoms of stacks and other coarse litter should be saved and used for potato mulching next spring. The mulched early potatoes have regularly yielded from one tenth to one fourth more than the unmulched. The mulched late potatoes have yielded from one half more to five times as much as the unmulched. The mulched potatoes will also keep in the ground much longer than the unmulched. (November, 1900.)

EARLY LETTUCE AND RADISHES.

Lettuce and radishes are about the first vegetables placed on the table in the spring. They are easily grown in the hot-bed and

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by this method can be placed on the table from four to six weeks earlier than if grown in the open garden. The seeds can be sown in the hot-bed in February and the plants may be placed on the table in March. There is little labor attached to their production after the hot-bed is made and the seed sown.

The bed should be made on the south side of a building or bank where it will receive all of the sunlight and be protected from the cold north winds. The bed of manure may be made in a pit prepared for that purpose, or on top of the ground. The soil should be a sandy loam and about five or six inches deep in the bed. The covering of the bed should slope to the south and be six or eight inches above the soil on the lowest side.

Early turnip radishes may be planted in the bed in February and the plants be ready for use in from three to five weeks. The seed should be planted in rows four or five inches apart and the plants thinned to two plants to the inch in the row. The thinning should be done soon after the plants are up. The soil must be kept moist and free from weeds and grass. A little surface cultivation will be of value. The bed will require little care after thinning the plants except that an even temperature must be kept.

Lettuce may be drilled in the bed the same as radishes but should be thinned more. It will take the lettuce longer to mature than the radishes and will require a better protected bed as the heat of the manure will be nearly if not entirely exhausted before the lettuce is mature.

Both crops require a low temperature and are easily kept in a hot-bed for a long time on that account. If the beds are covered with glass the seeds may be planted in February but if a cloth covering is used the seeds should be planted a little later, about the first of March. (January, 1901.)

EARLY RHUBARB OR PIEPLANT.

This vegetable can be forced into an early growth in the spring by covering the plants in the open garden with about one foot of fresh manure in February or March. The manure should cover a space two or three feet square about each plant. It is a good plan to place some boards or old barrels staves around the plant to hold the manure in place. If the boards are close together and stand a foot or so above the manure they will do a great deal to pro-

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tect the young leaves from the frost. After the manure has been on the ground for a few days a hole five or six inches in diameter should be dug over the plant in the manure to aid the plant in starting through the manure. Most of the early growth is made from the food stored in the roots the previous summer. To secure the best development of the plants and roots, the plants should be set in rows four feet apart and two feet apart in the row and given clean, shallow cultivation throughout the summer. Three or four inches of well-rotted manure should be well worked into the soil around the plant in the spring. Plants receiving good cultivation will last five or seven years without renewing. Forcing the plants may have a tendency to weaken them and shorten the life of the plantation.

Another method of forcing the plants is to lift the plants, with a large ball of the surrounding soil, from the garden and place in a cellar or slow hot-bed. Keep the roots well bedded in soil and moist. Light is not necessary for their growth. This method is quite satisfactory as it can be carried out any time during the winter. The plants will produce edible stems within four weeks after they are placed in their warmer location. The plants will do best if the ground has been frozen once or twice before plants are lifted from the garden. (February, 1901.)

ASPARAGUS.

Asparagus is found growing in very few gardens in Oklahoma. It is easily grown and makes a very nice dish in early spring when people are hungry for fresh vegetables The plants can be grown from seed, but it is best to start the patch from clumps of roots as it will be three or four years before the seedlings are large enough to produce good stems.

The plants should be set in rows five feet apart and the plants four feet apart in the row. The plants should be placed so the crowns will be about six inches below the surface of the soil. The bed should receive good clean cultivation in the summer and a good coating of manure in the winter. The old stems should be removed in the fall.

There are several methods of forcing the plants into early growth in the spring. A simple method of forcing enough for family use is to dig some large clumps from the patch, retaining as

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much soil as possible with the roots and place in a hot-bed. Keep the roots well watered and growth will start in a few days. Good clumps will furnish several cuttings but are of little value after being forced in this way. Another method is to spread fresh manure deep enough over the ground to heat. This method acts much slower than the one just described but doesn't destroy the plants. (February, 1901.)

ONION GROWING.

There is a good deal of complaint among farmers and gardeners about being unable to secure a good stand of onions by planting the seed. Onion seed deteriorates very rapidly with age and only that of the last season's crop should be used. The sprouting seeds and young plants are very easily killed by drouth and some method of planting must be followed that will carry the young plants over the dry weather in March.

A simple and quite effective way of planting is to prepare a good seed-bed by plowing the land in the fall or early winter. Smooth down the surface with a harrow or similar tool. Drill the seed in rows about fifteen inches apart, placing the seed about one inch below the surface of the soil. Firm the soil well on the seed by walking on the row or some similar method, then cover lightly with loose soil. This method, although simple, has never failed to give a good stand of onions at the experiment station.

As soon as the plants are three or four inches high they should be thinned to three inches apart in the row. Weeds and grass should never be permitted to grow in the onion bed and the surface of the soil should be kept loose and mellow with the hoe or hand cultivator. Onions are easily grown and with good care will yield a good crop in almost all parts of Oklahoma. (March, 1901.)

SPARROWS EATING GRAPES.

The English sparrow has destroyed a large part of the grape crop in some parts of Oklahoma this year. The crop is not bothered in any way until the fruit begins to ripen. The sparrow then splits the berry on one or two sides and eats part of the pulp. After the berry is split the bees, wasps and other insects soon destroy

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the entire pulp. The berry is seldom torn from the stem and the skin dries and withers on the bunch. The early varieties do not seem to be so badly attacked by the birds. No one variety seems to be attacked worse than others, but thin-skinned varieties suffer more than thick-skinned varieties. It was necessary this year to gather some of the later varieties before they were thoroughly ripe in order to prevent their entire destruction by the sparrows. (September, 1900.)

INSECT NOTES.

Several specimens of the so-called "Northern Leaf-footed Plant-bug" have been received at the experiment station from various parts of Oklahoma accompanied with the report that the bug was injuring the fruit of peaches and plums. They are reported as puncturing the fruits and sucking out the juices. This bug is quite closely related to the common squash bugs from which they are readily told by their rather more slender form and particularly by the peculiar leaf-like expansion of the hind legs. The bug has been known as an enemy of the cucumber, canteloupe, and other cucurbits, but this is the first recorded instance of their injuring peaches and plums. Farmers are asked to send to the station specimens of this insect whenever found and to search for the eggs that are probably deposited in rows on the under surface of leaves of cucumbers, squashes, etc. Such material will enable us to determine several points regarding the life history of the bug.

Growers of melons that have had their crops injured by the attacks of the melon-louse should write to the experiment station regarding the matter stating the amount of injury done and any facts that may have been secured regarding the life history of the lice.

Persons to whom the chinch bug infection has been sent during this season are requested to send a complete account of their experiments with it to the experiment station. These reports if carefully made and complete as to details of the methods used will be of great value to us and to the farmers of the territory.

No enemy of the cultivation of any crop in the territory should by neglect be allowed to become so widely distributed that its eradication becomes a matter of great difficulty and much expense.

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Experience has taught us that here as elsewhere the old adage is true that "A stitch in time saves nine."

Peach trees in the vicinity of Stillwater have been considerably damaged by the attacks of the parasitic fungus known as the "peach rust." We desire to secure specimens of this fungus from all parts of the territory and hope all who find it on their places will send some of the twigs and leaves of the infected trees to the experiment station for examination.

A number of correspondents have sent in for identification the so-called "false chinch bug" and reported that the bug was doing considerable damage to their fields of flax. This bug resembles the chinch bug in general appearance but differs from it in being smaller and in lacking the black spots on the wings that are so characteristic of the chinch bug. Its attacks are not yet known to be of a very severe character but it is one of the things that should be watched.

A number of peach growers have called attention to the fact that the large velvety-green beetle, often called June-bug in this region, was eating the peaches. These beetles fly about during the day with a buzzing sound similar to that of a bumble bee. Their injury to peaches in this region has not been great although hundreds could be seen buzzing about the trees at all times of the day for several weeks in July. The larvae of this beetle is the white grub of the south and is known as an eater of grass roots, we may therefore expect to know of the larva attacking the roots of corn. (August, 1900.)

BORERS IN TREES.

There are many orchards in Oklahoma that have suffered a heavy and unnecessary loss during the last summer from the attacks of borers. Many farmers do not notice that there is any thing wrong with the trees until the leaves turn yellow and begin to fall in midsummer. After this stage has been reached there is little hope for the tree and it dies before frost. A glance at the tree will be sufficient to see that the bark on the trunk is dead and black in irregular spots and lines. Just beneath the dead bark is the borer's burrow filled with worm dust. The borer is too familiar to require description. He works up and down the side of the tree and finally burrows to the center. When two or three borers

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get into the same tree the trunk is girdled and the tree killed. In many cases the borer works on only one side of the tree.

If a large spot of bark is killed, the bark and wood begins to rot and are soon filled with a mushroom growth. This mushroom breaks through the bark of the tree and develops the fruiting portion on the outside of the trunk. The fruiting part is white and resembles that which is seen on rotten logs. If the tree dies the rot is then supposed to be the cause of its death. The rot may hasten the death of the tree, but a tree that is sound and free from blemishes is very seldom if ever attacked by this rot.

The best thing to do is to keep the tree free from borers and other injuries. The land should be kept free from grass and weeds and well cultivated. Good, clean cultivation is worth more than all the washes and dressings that can be applied to prevent borers. A good wash, however, is often worth many times what it costs to apply and will do much toward preventing the attacks of borers and other insects. A one pound can of concentrated lye dissolved in two or three gallons of water makes a very good tree wash. Another good wash can be made of one half pint of pine tar, one half pint carbolic acid, and two gallons of soft soap. These washes can easily be applied with an old white-wash brush or a swab made of old rags tied on the end of a stick. These washes should be applied two or three times to the trunk and large limbs during the spring and early summer.

INSECTS IN STORED GRAIN.

All stored grain should be watched more or less to prevent the attacks of insects or mice during the winter. Carbon-bisulphide forms the best and most efficacious method of exterminating these pests. It is a colorless liquid that evaporates readily at ordinary temperatures to form a gas with a strong odor that is a strong poison and is very inflammable. Care should be taken never to allow any light in the neighborhood of the gas and this refers as well to lighted cigars and pipes.

For each 100 bushels of grain to be treated employ about one pound of the carbon-bisulphide. Place it in several open flat dishes that are to be evenly distributed over the surface of the grain. Cover the dishes and grain thoroughly with blankets, oil-cloth or

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other good cover and after 24 hours examine to see if all the mice and insects have been killed. If not apply the same treatment again. Its success is certain.

The carbon-bisulphide is retailed at the drug stores at about 25 cents per pound, but may be purchased in rather larger quantities at a smaller figure. (October, 1900.)

CHINCH BUGS.

On September 17, 1900, a circular was sent out from the experiment station to over four hundred wheat growers of the territory regarding the prevalence of the chinch bug and the success attending the use of the infection and other methods of destroying this well known pest. Many of these persons had received from the station during one or more seasons some of the chinch bug infection for trial on their places and it was desirable to collect the statements of these persons as to the results secured by them on a large scale. The following are the questons to which answers were requested:

1. Have you found any chinch bugs this year? During what year did you first notice the bug in your crops?
2. Were they more abundant this year than during preceding years?
3. What did you do with the infection which you received from the station?
4. Do you consider that the infection has reduced the numbers of chinch bugs?
5. Have you employed any other method of exterminating the bugs?

In answer to these circulars there were received about two hundred and fifty replies of which one hundred and eight came from persons who had employed the infection on their places during one or more years. These one hundred and eight replies represent twenty-two of the counties of the territory and two of the nations of the Indian Territory.

In all parts of "Old Oklahoma" the bugs were noticed during the year 1890 or shortly thereafter while in the "Strip" the bugs were present as a rule in the first wheat crop raised. They have been present during each of the following years in greater or less numbers and were present in the wheat and sorghum during the

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past season in many parts of the territory. According to the replies the bugs were not more numerous this year than during previous years though in a few localities they have done more damage this year than ever before. From the information at hand it is not possible to detect any evidence of migration from one part of the territory to another, though some report that such is the case.

The replies to the fourth question were rather conflicting and are therefore tabulated below for reference:

Yes—50.
No— 22.
?——36.
Total, 108.

To the 50 replying "yes" might be added 16 others who answered "yes" but who were for one reason or another in doubt as to their reply. In many cases the experiment had been tried during very dry weather and failed for the very simple reason that at that time or rather under those conditions the fungus was unable to grow as rapidly as required. Experiments tried during wet weather were as a rule successful for under these conditions the fungus is able to vetgetate rapidly and the "infection" spreads rapidly. Of course the death of the bugs during moist, damp weather must not be confused with the death due solely to the presence of the infection, and since the greatest damage done by the bugs is during dry weather, when the fungus is unable to grow rapidly, it can hardly be expected that great or paying success will attend the use of the infection on a large scale. The station will be glad to supply persons with the infection for such use but suggests that it is often possible for the farmer to find a great abundance of the infected dead bugs about the bases of the old corn or sorghum stems.

Very few persons had attempted to make use of any other method for exterminating the bugs. The most important methods suggested in these answers are tabulated for reference:

1. Many have found it wise to burn all the stubble off the ground.

2. Some form of the "barrier" method has in many phases been found useful and practical on a large scale.

3. The planting of "catch crops" is highly recommended by many and seems to be worthy of trial in more parts of the territory.

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4. One of the correspondents reports that the "lady bugs" were rendering valuable assistance in destroying the bugs.

5. Another person says that the Pekin ducks had eaten many of the bugs on his place Attempts should be made to induce other domestic fowls to eat the bugs for the rapid destruction of a few when they first appear on a few rows of the crop may save the entire field.

6. Spraying the stems of corn and sorghum with boiling hot water proved satisfactory in some cases though the use of Paris green and kerosene emulsion proved of no avail.

Experiments along some of the lines mentioned are to be undertaken at the station during the coming season and in the meantime notes from persons who have had success with any method are very desirable and will greatly assist in combating this great insect enemy. (December, 1900.)

THE MELON LOUSE.

Melon growers should consider at this time of the year any steps that they propose taking for preventing the ravages of the melon louse during the coming season. It is too late to do anything after the lice appear. Their habits are such that no effective spraying or other general treatment is possible.

Two methods have been suggested looking toward the prevention of loss. One consists in thoroughly cleaning up and plowing the old melon fields now, if melons are to be planted on the same land next year. This serves to destroy many of the insects which pass the winter in the trash and litter of the old melon field.

Perhaps a better method is to change the crop on the old field and grow melons in a new place. If this plan of rotation is followed, it discourages the insects and gives them nothing to work on at the old location and it takes considerable time for them to find the new one. (January, 1901.)

BAG WORM AND SAN JOSE SCALE.

Frequent inquiries are received regarding the "bag-worm" whose peculiar sacs or bags are frequently seen during the winter attached to various trees and other objects. If these sacs are ex-

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amined, some will be found to contain a large number of eggs within a mass of yellow fluffy material. The empty cases are the ones that were occupied by the male during the past growing season while the larger ones, containing the mass of eggs, were the abode of the females. The females in fact never leave the cases and after fertilization by the small male moths, the eggs are formed as already described. From these eggs are hatched, in the spring, the larvae that begin feeding on the leaves of trees at once and soon form about themselves the bag that is enlarged as the larvae mature until it becomes too large for them to carry. Then it is attached to the limb while the larvae is eating and is moved to another place when the food supply is there exhausted. Every one of these cases should be removed from the trees during the winter and burned as otherwise the larvae are certain to destroy a good number of shade trees in the spring.

A few fruit growers have called attention to a rumor that the San Jose scale has been seen this winter in some parts of Oklahoma. If any fruit grower or nurseryman has seen specimens of scale insects that seem to be the true San Jose scale, specimens and notes regarding them should at once be sent to the experiment station so that this very dangerous insect may be prevented from securing a foothold in the territory. (February, 1901.)

HESSIAN FLY.

The Hessian Fly is a small, dark-colored, two-winged insect about one eighth of an inch in length. This fly passes the winter in the stage called the "flax seed" stage. This "flax-seed" is really only the dried external skin of the larval stage of the insect. In the spring the regular pupa is formed and in a short time the adult insect appears. The adult deposits her eggs usually on the upper side of the leaves of wheat and then in a few days, having finished her task, dies. The young that hatch from these eggs soon work their way down to one of the lower nodes or joints of the stem. Here they pass into the larval stage and the characteristic "flax-seed" stage may be found in the wheat during the entire summer. The damage is due to the resulting stunting of the stem and the frequent "lodging," of the grain that results. The application of any insecticide is absolutely hopeless against this result and modified farm practice is the only avenue of escape.

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In the north two broods are formed but in Oklahoma we should expect to find more broods during the season. The last brood formed during the season also deposit their eggs upon the leaves and the young in this case make their way down to the lowest joint beneath the ground. The flax-seed stage is entered upon and the season's work of the insect is closed. The date at which the fall brood deposit their eggs varies with the latitude, that is, with the temperature and hence we should expect to find the insect depositing its eggs earlier in the northern part of the territory than in the southern part. Knowing this date, in any given latitude wheat should be planted so late that the insect will be forced to deposit the eggs in some other grass in the neighborhood. If late sowing proves impossible or is not advisable for any reason then it will be of advantage to pasture the early sown fields. All the stubble that is standing after the crop is harvested in the summer should be burned as in this way all the larvae that are found in the stems in the flax-seed stage will be killed and the numbers of the fall brood greatly reduced.

In order to enable the experiment station to give practical advice regarding the time of planting of wheat and to avoid this dangerous enemy, reports are desired from all wheat growers of Oklahoma regarding the appearance of the insect in their localities last fall and this spring. (April, 1901.)

THE GRAIN-LOUSE VERSUS WHEAT.

It is appropriate at this time to notice this insect whose ravages in wheat in several counties of Oklahoma have greatly reduced the value of this year's crop. By extensive correspondence and by conversations with many wheat growers, uniform testimony is secured that throughout the regions named below the wheat or grain-louse has greatly damaged this year's crop. In fact the injury in some regions has been so great that farmers have preferred to replant the wheat ground to some other crop. A recommendation to this effect was inserted in some of the newspapers of the territory some time ago.

The station received the first specimens of this louse early in April, and the Entomologist has since that time given most of his time to a thorough investigation of the distribution and life history of the insect. It became at once apparent that the main dam-

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age was not due to the well known "grain-louse" (Siphonophora avenae), whose structure and life history have been so well aired in the newspapers of late. Our form differs from the one mentioned in several details and will soon be described as a new variety closely related to the true "grain-louse."

The greatest injury to wheat has occurred in the following regions: Chickasaw and Cherokee Nations and Cleveland, Canadian, Kingfisher, Lincoln, Logan, Noble, Oklahoma, Payne, Pawnee and Pottawatomie counties. In some cases it was noted that the general trend of the migrations of the insect was from south to north. The louse, like its better known relative, is capable of very rapid multiplication and this is favored by dry weather. Males are unknown and the reproduction is by the process called parthenogenesis, or the giving birth to the living young. The viviparous females are wingless but enough winged females are produced to enable the species to migrate from one field to another in search of food. These winged females were present in large numbers from about the middle of April to the first of May.

There is no evidence that this louse has a true egg-stage. It is probable that it winters over in the adult stage and feeds upon the leaves of the wheat during favorable weather during the entire winter. The past winter was in some respects very favorable to the development of the louse in large numbers and it is not therefore a matter for surprise that such hordes of lice should have appeared so early in the spring.

There is no practical spraying method that can be recommended against this insect pest. Some have suggested spraying with the usual kerosene emulsion and this would probably reduce their number if applied before they spread over so large an area as to make the plan quite impossible and too costly. Our greatest hope lies, however, in the rapid multiplication and energy of the natural insect enemies of this louse. The most abundant and useful of these enemies in Oklahoma is surely one of the "lady-bird" beetles (Hippodamia convergens.) This is a nearly hemispherical beetle about three-sixteenths of an inch in length and of a reddish-yellow color with several black spots on the back. The head and thorax are black with reddish-yellow margins and the thorax has two elongated reddish-yellow spots.

The larvae of these beetles are even more rapacious and active than the mature beetles. The larva is a long, blackish, somewhat flattened, and very active larva with six legs of more than usual

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length. The larva when it reaches maturity curls up on some leaf or stem and changes to the pupa from which the mature beetle emerges in a few days. The beetles live over winter in the mature stage in crevices of trees and boards. These "lady-bird" beetles have appeared in such large numbers in some parts of Oklahoma that farmers have written to the experiment station for some remedy to destroy them. Every wheat grower should look on these beetles as his best friend and in no case allow them to be destroyed.

Specimens of the wheat louse and especially specimens of all the beetles found in the wheat fields are very much desired by the experiment station and may be sent through the mail if enclosed in tin or wooden boxes. (May, 1901.)

BEE-KEEPING.

In order to be able to answer inquiries in regard to bee keeping in Oklahoma, the experiment station purchased three colonies in March, 1899. Up to July 1, 1900, the indications are that on the upland prairies with the ordinary attention given to bees, they will store but little surplus honey. On the other hand, they will need to be fed heavily in the fall in order to have them winter safely. If one is located in a river bottom and is an experienced bee keeper, he may secure some surplus honey by giving bees extraordinary care. (August, 1900.) [The station has since discontinued bee experiments.]

INSTITUTE AT TONKAWA.

A successful farmers' institute was held at Tonkawa, Oklahoma, March 6 and 7. In addition to several speakers from Kay County, Dr. L. L. Lewis spoke on "Infectious and Contagious Diseases of Cattle and Hogs," Prof. O. M. Morris spoke on "Fruits and Flowers for the Farm," and Pres. A. C. Scott of the Oklahoma Agricultural and Mechanical delivered an address.

The Oklahoma Agricultural Experiment Station has one more institute scheduled for the present season. Interest in farmers' institutes is increasing and localities which desire aid next season should notify the station so as to be included when the lists are made

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up. Unless this is done, the station will be unable to render the assistance which it wishes to give. (March, 1901.)

THE SHORT COURSES.

Twenty-five young men are attending the short courses in agriculture, horticulture, and the mechanic arts which are now being given at the Oklahoma A. and M. College at Stillwater. They are studying the work of the experiment station very closely and are finding much that will be helpful to them when they return to their farms. (January, 1901.)

NO FREE SEEDS.

The experiment station at Stillwater has no plants or seeds for free distribution or sale. The station publications, however, are sent free to all citizens of Oklahoma who request them. (January, 1901.)

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FARM POULTRY KEEPING

INTRODUCTION.

Oklahoma and Indian Territories seem to be naturally adapted to the growing of domestic fowls. Before the country was so thickly settled, wild turkeys and prairie chickens were abundant and even yet, a few survive. Quail still furnish both sport and food and the number killed each season, though quite large, seems to be without appreciable effect in diminishing the next season's supply.

This article is published for the purpose of supplying information concerning the important subject of poultry keeping and is practically a reprint, by permission, of Farmers' Bulletin No. 11, Fowls: Care and Feeding, by G. C. Watson, published by the U. S. Department of Agriculture.

"Large numbers of rural population live more or less isolated and find it inconvenient, if not impossible, to supply fresh meat daily for the table aside from that slaughtered on the farm; and of all live stock, poultry furnishes the most convenient means of supplying an excellent quality of food in suitable quantities. This is particularly true in hot summer months, when fresh meat will keep only a short time with the conveniences usually at the farmer's command.

"Although fowls require as wholesome food as any class of live stock, they can be fed perhaps more than any other kind of animals on unmerchantable seeds and grains that would otherwise be wholly or partially lost. These seeds often contain various weed seeds, broken and undeveloped kernels, and thus furnish a variety of food which is always advantageous in profitable stock feeding. There is less danger of injury to poultry from these refuse seeds than is the case with any other kind of animals. As a rule, noxious weed seeds can be fed to fowls without fear of disseminating the seeds through the manure, which is not generally true when the weed seeds are fed to other classes of live stock, particularly in any considerable quantity.

SELECTION OF SITE FOR BUILDINGS AND YARDS.

"Too often the location of the poultry house is thought to be of minor importance, and consequently is given less consideration than that of any other farm building. Frequently the other build-

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ings are located first and the poultry house then placed on the most convenient space, when it should have received consideration before the larger buildings were all located.

"In caring for the various classes of live stock, the question of labor is always an important item, and the class that requires the closest attention to petty details, as a rule, requires the greatest amount of labor. As poultry keeping is wholly a business of details, the economy of labor in performing the necessary work is of great importance. Buildings not conveniently located and arranged become expensive on account of unnecessary labor.

"As it is necessary to visit poultry houses several times each day in the year, convenience is of more importance than in case of almost any other farm building. The operations must be performed frequently, so that any little inconvenience in the arrangements of the buildings will cause not only extra expense in the care, but in many cases a greater or less neglect of operations that ought to be performed carefully each day.

"Poultry houses are likely to be more or less infested with rats and mice, unless some means are provided to exclude them, and this should be taken into account in selecting a location. It is generally best to locate the poultry house at some distance from other farm buildings, especially if grain is kept in the latter. Convenience of access and freedom from vermin are two desirable points to be secured, and they depend largely upon the location. Everything considered, it is safest to have the house quite isolated.

"A dry, porous soil is always to be preferred as a site for buildings and yards. Cleanliness and freedom from moisture must be secured if the greatest success is to be attained. Without doubt, filth and moisture are the cause, either directly or indirectly, of the majority of poultry diseases, and form the stumbling block which brings discouragement and failure to many amateurs. It must not be inferred that poultry can not be successfully reared and profitably kept on heavy soils, for abundant proof to the contrary is readily furnished by successful poultrymen who have to contend with this kind of land. The necessity of cleanliness, however, is not disputed by those who have had extended experience in caring for fowls, particularly the less hardy breeds. That an open, porous soil can be kept comparatively clean with much less labor than a clay soil will be evident to those who are at all acquainted with the habits of domesticated fowls. When the fowls are confined in buildings and yards, that part of the yard nearest the

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buildings will become more or less filthy from the droppings and continual tramping to which it is subjected. A heavy or clayey soil not only retains all of the manure on the surface, but by retarding percolation at times of frequent showers aids materially in giving to the whole surface a complete coating of filth. If a knoll or ridge can be selected where natural drainage is perfect, the ideal condition will be nearly approached. Where natural favorable conditions as to drainage do not exist, thorough underdrainage will go a long way toward making the necessary amends to insure success.

CONSTRUCTION OF HOUSES.

"The material to be used in the construction and the manner of building will necessarily be governed largely by the climatic conditions.

"In general, it may be said that the house should provide warm, dry, well-lighted, and well-ventilated quarters for the fowls.

"In order to meet these requirements it will be necessary to provide a good roof with side walls more or less impervious to moisture and cold, suitable arrangements for lighting and ventilating, and some means for excluding the moisture from beneath. Where permanent buildings are to be erected, some provision should be made to exclude rats and mice, and for this reason, if for no other, the structure should be placed on cement walls with foundation below the frost line. Cheap, efficient walls may be made of small field stone in the following manner: Dig trenches for the walls below the frost line; drive two rows of stakes in the trenches, one row at each side of the trench, and board inside of the stakes. The boards simply hold the stones and cement in place until the cement hardens. Rough and uneven boards will answer every purpose except for the top ones, which should have the upper edge straight and be placed level to determine the top of the wall. Place two or three layers of stone in the bottom of the trench, put on cement mixed rather thin, and pound down; repeat this operation until the desired height is obtained. The top of the wall can be smoothed off with a trowel or ditching spade and left until the cement becomes hard, when it will be ready for building.

"The boards at the sides may be removed, if desirable, at any time after the cement becomes hard.

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"A cheap, effcient house for this latitude may be made of two thicknesses of rough inch lumber for the side and end walls. This siding should be put on vertically, with a good quality of tarred building paper between. In constructing a building of this kind, it is usually best to nail on the inner layer of boards first; then put on the outside of this layer the building paper in such a manner that the whole surface is covered. Where the edges of paper meet, a liberal lap should be given, the object being to prevent as far as possible drafts of air in severe weather. Nail the second thickness of boards on the building paper so as to break joints in the two boardings. In selecting lumber for siding, it is best to choose boards of a uniform width to facilitate the breaking of joints.

"In preparing plans for a building, one of the first questions to be decided upon is the size and form of the house. If the buildings are made with the corners right angles, there is no form so economical as a square building. This form will enclose more square feet of floor space for a given amount of lumber than any other, but for some reasons a square building is not so well adapted for fowls as one that is much longer than wide. It is essential to have the different pens or divisions in the house so arranged that each one will receive as much sunlight as possible, and to secure this, some sacrifice in economy of building must be made.

"The writer prefers a building one story high, and not less than 10 nor more than 14 feet wide, and as long as circumstances require. In most cases a building from 30 to 60 feet long meets all requirements. If this does not give room enough, it is better to construct other buildings than to extend one building more than 60 feet. It must be remembered that each pen in the building should have a separate yard or run, and that a pen should not be made to accommodate more than 50 fowls, or, better, 30 to 40.

"The building should extend nearly east and west in order that as much sunshine as possible may be admitted through windows on the south side. The windows should not be large nor more than one to every 8 or 10 feet in length for a house 12 feet wide, and about 17 inches from the floor, or at such height that as much sunshine as possible will be thrown on the floor. The size and form of the windows will determine quite largely their location. One of the common mistakes is putting in too many windows.

"While a building that admits plenty of sunlight in the winter time as desirable, a cold one is equally undesirable, and windows are a source of radiation at night unless shutters or curtains are

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provided. Sliding windows are preferred on many accounts. They can be partially opened for ventilation on warm days. The base or rail on which the window slides should be made of several pieces fastened an inch or so apart, through which openings the dirt which is sure to accummulate in poultry houses may drop and insure free movement of the window.

VENTILATION.

"Some means of ventilating the building should be provided. A ventilator that can be opened and closed at the will of the attendant will give good results if given proper attention, and without attention no ventilator will give the best results. All ventilators that are in continuous operation either give too much ventilation during cold and windy weather or not enough during still, warm days. As a rule, they give too much ventilation at night and too little during the warm parts of the day. Ventilators are not needed in severe cold weather, but during the first warm days of early spring, and whenever the temperature rises above freezing during the winter months some ventilation should be provided. Houses with single walls will become quite frosty on the inside during severe weather, which will cause considerable dampness whenever the temperature rises sufficiently to thaw out all of the frost of the side walls and roof. At this time a ventilator is most needed. A ventilator in the highest part of the roof that can be closed tightly by means of cords or chains answers the purpose admirably and may be constructed with little expense. The ease and convenience of operation are important points, and should not be neglected when the building is being constructed. It is a simple matter for the attendant to open or close a ventilator as he passes through the house if the appliances for operating it are within easy reach.

PERCHES.

"Perches should be not more than 2½ feet from the floor, and should all be of the same height. Many fowls prefer to perch as far above the ground as possible, in order, without doubt, to be more secure from their natural enemies; but when fowls are protected artificially from skunks, minks, foxes, etc., a low perch is just as safe and a great deal better for the heavy bodied fowls. It must be borne in mind that the distance given at which perches should be placed from the floor applies to all breeds of fowls. It

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is true that some of the Mediterranean fowls would not in any way be injured in flying to and from the perches, but some of the heavy breeds would find it almost impossible to reach high perches and would sustain positive injuries in alighting on the floor from any considerable elevation. Convenient walks or ladders can be constructed which will enable the large fowls to approach the perches without great effort, but there are always times when even the most clumsy fowls will attempt to fly from the perch to the floor and come down with a heavy thud, which is often injurious. And furthermore, ladders or stairs for the easy ascent of fowls are more or less of a nuisance in the poultry house. The ideal interior arrangement of the house is to have everything that is needed in as simple a form as possible and not to complicate the arrangement by any unnecessary apparatus. The fewer and simpler the interior arrangements the easier the house can be kept clean, and the greater the floor space available for the fowls.

"There is no reason why all perches should not be placed near the floor. Movable perches are to be preferred. A 2 by 3 scantling set edgewise, with the upper corners rounded, answers every purpose and makes a satisfactory perch. The perches should be firm and not tip or rock. The form of the scantling makes it easy to secure them firmly and still have them removable.

"Underneath the perches should always be placed a smooth platform to catch the droppings. This is necessary for two reasons: the droppings are valuable for fertilizing purposes and ought not to be mixed with the litter on the floor; then, too, if the droppings are kept separate and in a convenient place to remove, it is much easier to keep the house clean than when they are allowed to become more or less scattered by the tramping and scratching of fowls. The distance of the platform from the perch will be governed somewhat by the means employed for removing the droppings. If a broad iron shovel with a tolerably straight handle is used, the space between the platform and perches need not be more than 6 inches. The droppings should be removed every day.

NESTS.

"In constructing nest boxes, three points should be kept constantly in mind: (1) The box should be of such a nature that it can be readily cleaned and thoroughly disinfected; if it is removable so that it can be taken out of doors, so much the better: (2) it should be placed in the dark, or where there is only just sufficient light for

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the fowl to distinguish the nest and the nest egg; (3) there should be plenty of room on two or three sides of the nest. It is a well-known fact that some hens in seeking a nest will always drive off other hens, no matter how many vacant nests may be available. If the nest is so arranged that it can be approached only from one side, when one hen is driving another from the nest there is likely to be more or less of a combat, the result of which is often a broken egg. This, perhaps, more than any other one thing, leads to the vice of egg eating. To the writer's knowledge, the habit of egg eating is not contracted when the nests are arranged in the dark and open on two or three sides. Nests for Leghorns or Hamburgs may be made of 6-inch fence boards nailed together so as to form boxes 8 by 10 inches and 6 inches deep Where perches are arranged with the platform underneath to catch the droppings, as previously described, the nests may be placed on the floor underneath this platform, the opening in front closed with a door which either lets down from the top or lifts from the bottom. Where nests are placed side by side it is necessary to have the partitions between them of sufficient height so that it will be impossible for a hen to draw eggs from one nest to another. Whenever the next boxes are filled so full with nest material that a hen can draw an egg from one nest to another some of the eggs are likely to be broken.

DRINKING FOUNTAINS.

"One of the most difficult problems for the poultryman to solve is how to easily provide pure, fresh water for his fowls. Many patent fountains which are on the market are automatic and keep before the fowls a certain quantity of water. Under certain conditions these fountains serve an admirable purpose. Under more adverse conditions many of these patent contrivances fail to give satisfaction for the simple reason that it is impossible to keep them clean. If fowls were fed only whole grain and the weather was always cool, it would be a comparatively easy matter to provide satisfactory automatic drinking fountains, but as soft food forms a considerable portion of the diet for laying hens and fattening fowls, these fountains are necessarily more or less fouled and in warm weather soon become unfit for use as drinking fountains on account of the tainted water and disagreeable odor.

"A simple, wholesome arrangement may be made as follows: Place an ordinary milk pan on a block or shallow box, the top of which shall be 4 or 5 inches from the floor. The water or milk to be

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drunk by the fowls is to be placed in this pan. Over the pan is placed a board cover supported on pieces of lath about 8 inches long, nailed to the cover so that they are about 2 inches apart, the lower ends resting upon the box which forms the support of the pan. In order to drink from the pan it will be necessary for the fowls to insert their heads between these strips of lath. The cover over the pan and the strips of lath at the sides prevent the fowl from fouling the water in any manner, except in the act of drinking. Where drinking pans of this kind are used, it is very easy to cleanse and scald them with hot water as occasion demands. This arrangement can be carried a little further by placing a pan, or, what would be still better, a long narrow dish, something like a tin bread tray, on a low shelf a few inches from the floor, and hinging the cover to one side of the poultry house so that it can be tipped up in front for the removal of the dish or for filling it with water. Whatever device is used, it must be easily cleaned and of free access to the fowls at all times.

DUST BOXES.

"It is necessary to provide dust boxes for the fowls during the winter months if they are to be kept free from lice. If the soil in the yards is naturally dry and porous, abundant opportunities will be had for dust baths during the warm summer months, but during the late fall, winter, and early spring some artificial provisions must be made. A comparatively small box will answer the purpose if the attendant is willing to give a little attention to it each day. These boxes should be placed so they will receive some sunshine on each bright day, and be kept filled with loose fine earth. Road dust procured during the hot dry, months of July and August from much-traveled roads has no superior for this purpose. Probably there is no way in which the poultry man can better combat the body louse than by providing dust boxes for his fowls.

YARDS OR PARKS.

"Where fowls are kept in confinement it will be found best to provide out door yards or runs for them during the summer months. Give them free access to these yards whenever the weather will permit. The most economical form, everything considered, for a poultry yard is one much longer than wide. Two rods wide and 8 rods long is sufficient for 50 fowls. Whenever a poultry plant of considerable size is to be established it will be found most economical

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to arrange the yards side by side, with one end at the poultry house. The fences which inclose these yards may be made of poultry netting or pickets, and should be at least 7 feet high. In either case it is best to have a board at the bottom, for sometimes it will be desirable to give quite young chickens the run of these yards. If the poultry yards are constructed as described, there is sufficient room for a row of fruit trees down the center of the yard, and still leave ample room for horse cultivation on either side, either with one or with two horses.

"These yards are to be kept thoroughly cultivated. If thought best, grain may be sown before cultivation to furnish part of the green food for the fowls. Of all fruit trees, probably there are none that are more suitable for the poultry yard than the plum. The droppings of the fowls will manure the trees, and the fowls as insect destroyers perform a great office in protecting plums from the curculio. After the trees are once well established, a crop of plums should be secured nearly every year. These, too, will require no extra cultivation. The plum trees perform a valuable service in providing shade for the fowls. Where trees are not available, sunflowers may be used for this purpose with a considerable degree of satisfaction. However, some protection must be given the plants until they are well established, and even then many plants will be destroyed unless the fowls have an abundance of green food all the time.

"Hamburgs and Leghorns, if they are frequently moved from one pen to another, will sometimes give the owner considerable trouble in flying over fences, even though they are 7 feet high. If it is possible to place the fowls when they are quite young in the yard where they are to remain, much less trouble will be experienced. It has often been noticed that hens would remain peacefully in the yard where they have been reared, but if moved to another yard would give the owner more or less trouble by flying over the inclosure.

SELECTION OF BREEDS AND BREEDING.

"A mistake is oftentimes made in selecting fowls of a breed that is not suited for the purpose for which they are to be kept. If egg production is the all-important point, it is a most serious mistake to select a breed of fowls that is not noted for this product. If, on the other hand, meat is the chief object, an expensive mis-

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take will be made if any but the heavy-bodied fowls are chosen. The small, active, nervous, egg-producing breeds can not compete with the larger phlegmatic Asiatics for meat production. Then, too, if fowls are kept for both eggs and meat production, some breed of the middle class should be chosen. These, while they do not attain the great size of Asiatics are sufficiently large to be reared profitably to supply the table with meat, and at the same time have the tendency for egg production developed sufficient to produce a goodly number of eggs during the year. The Wyandottes and Plymouth Rocks are good illustrations of this class of fowls. While individuals of these breeds have made excellent records in egg production, the records of large numbers do not compare favorably with the egg production of the Mediterranean fowls. All of the so-called Mediterranean fowls have a great tendency toward egg production and require only the proper food and care to produce eggs in abundance.

"A serious mistake is also made in selecting fowls for breeding purposes and in selecting eggs for hatching. On many farms the custom is to select eggs for hatching during the spring months, when nearly all of the fowls are laying. No matter how poor a layer a hen may be, the chances are that most of the eggs will be produced during the spring and early summer months. A hen that has laid many eggs during the winter months is quite likely to produce fewer eggs during the spring and early summer months than one that commenced to lay on the approach of warm weather. Springtime is nature's season for egg production. All fowls that produce any considerable number of eggs during the year are likely to be laying at this time. It is therefore plain that whenever eggs are selected in the springtime from a flock of mixed hens, composed of some good layers and some poor ones, a larger per cent of eggs will be obtained from the poor layers than at almost any other season of the year. A serious mistake is therefore made in breeding largely from the unprofitable fowls. Whenever it is possible, fowls that are known for the great number of eggs they have produced during the year should be selected for the breeding pen. While it will be almost impossible, and certainly impracticable, in the majority of cases to keep individual records of egg production, yet a selection may be made that will enable the breeder to improve his stock greatly.

"The two things necessary to produce large quantities of eggs with the Mediterranean fowls are: (1) Proper food and care, and

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(2) a strong constitution, which will enable the fowls to digest and assimilate a large amount of food; in other words, fowls so strong physically that they will stand forcing for egg production. In this relation, we may look at the fowl as a machine. If that machine is so strong that it can be run at its full capacity all the time, much greater profit will be derived than if it can be run at its full capacity only a part of the time.

"There is, perhaps, no time in the history of the fowl that will indicate its vigor so well as the molting period. Fowls that molt in a very short time and hardly stop laying during this period, as a rule, have strong, vigorous constitutions, and if properly fed give a large yearly record. On the other hand, those that are a long time molting have not the vigor and strength to digest and assimilate food enough to produce the requisite number of eggs. If it is necessary to select fowls at sometime during the year other than the molting period, some indication of the egg-producing power is shown in their general conformation.

"In selecting a hen for egg production, her form will give some indication of value. A long, deep-bodied fowl is to be chosen rather than one with a short body, whose underline is not unlike a half circle. A strong, hearty, vigorous fowl usually has a long body, a deep chest, with a long and quite straight underline. Other things being equal, the larger bodied fowls of the egg breeds are to be preferred. It is a rule that fowls bred for egg production are larger bodied than those bred for fancy points. Whenever vigor and constitution form an important part in the selection of fowls for breeding, the size of the fowls is invariably increased.

FEEDING.

"In feeding for egg production, a valuable lesson may be learned from nature. It will be observed that our domestic fowls that receive the least care and attention, or, in other words, whose conditions approach more nearly the natural conditions, lay most of their eggs in the spring-time. It is our duty, then, as feeders, to note the conditions surrounding these fowls at that time. The weather is warm, they have an abundance of green food, more or less grain, many insects, and plenty of exercise and fresh air. Then, if we are to feed for egg production, we will endeavor to make it springtime all the year round; not only to provide a warm place for our fowls and give them a proper proportion of green food, grain, and meat, but also to provide pure air and plenty of exercise.

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"Farmers who keep only a small flock of hens, chiefly to provide eggs for the family, frequently make a mistake in feeding too much corn. It has been clearly proven by experiment that corn should not form a very large portion of the grain ration for laying hens; it is too fattening, especially for hens kept in close confinement. Until the past few years, corn has been considered the universal poultry food of America. This, no doubt, has been largely brought about by its cheapness and large distribution. The recent low prices of wheat have led farmers to feed more of this grain than formerly, and with a consequent improvement in the poultry ration.

"When comfortable quarters are provided for the fowls, the nutritive ratio of the food should be about 1:4; that is, one part of protein or muscle-producing compounds to four parts of carbohydrates or heat and fat-producing compounds. Wheat is to be preferred to corn. Oats make an excellent food, and perhaps come nearer the ideal than most any other single grain, particularly if the hull can be removed.

"In forcing fowls for egg production, as in forcing animals for large yields of milk, it is found best to make up a ration of many kinds of grain. This invariably gives better results than one or two kinds of grain, although the nutritive ratio of the ration may be about the same. It has been found by experiment that the fowls not only relish their ration more when composed of many kinds of grains, but that a somewhat larger percentage of the whole ration is digested than when it is composed of fewer ingredients. It has been clearly proven by experiment that food consumed by the fowls influences the flavor of the eggs; that in extreme cases not only is the flavor of the food imparted to the eggs, but also the odor. This of itself is sufficient reason for always supplying wholesome food for the fowls and seeing to it that none but wholesome food is consumed.

"It is conceded by the majority of poultrymen that ground or soft food should form a part of the daily ration. As the digestive organs contain the least amount of food in the morning, it is desirable to feed the soft food at this time, for the reason that it will be digested and assimilated quicker than whole grain. A mixture of equal parts, by weight, of corn and oats ground, added to an equal weight of wheat bran and fine middlings, makes a good morning food if mixed with milk or water, thoroughly wet without being sloppy. If the mixture is inclined to be sticky the proportion of

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bran should be increased. A little linseed meal will improve the mixture, particularly for hens during the molting period, or for chickens when they are growing feathers. If prepared meat scrap or animal meal is to be fed it should be mixed with this soft food in proportion of about 1 pound to 25 hens. It will be necessary to feed this food in troughs to avoid soiling before it is consumed.

"The grain ration should consist largely of whole wheat, some oats, and perhaps a little cracked corn. This should be scattered in a litter which should always cover the floor of the poultry house. It is necessary to have the floor of the poultry house covered with a litter of some kind to insure cleanliness. Straw, chaff, cut cornstalks, all make excellent litters. The object of scattering the grain in this litter is to give fowls exercise. All breeds of fowls that are noted for egg production are active, nervous, and like to be continually at work. How to keep them busy is a problem not easily solved. Feeding the grain as described will go a long way toward providing exercise. If the fowls are fed three times a day they should not be fed all they will eat at noon. Make them find every kernel. At night, just before going on the perches, they should have all they will eat up clean. At no time should mature fowls be fed more than they can eat. Keep them always active, always on the lookout for another kernel of grain."

Kafir heads furnish a desirable food for this purpose. Experience of poultrymen and digestion experiments (Okla. Bulletin No. 46) have shown that Kafir corn is an excellent food for chickens. Cowpeas and soy beans are easily grown and are a cheap source of protein which is essential to growth and egg production.

GREEN FOOD.

"While perhaps not strictly necessary for their existence, some kind of green food is necessary for the greatest production of eggs. Where fowls are kept in pens and yards throughout the year, it is always best to supply some green food. The question how to supply the best food most cheaply is one that each individual must solve for himself. In a general way, however, it may be said that during the winter and early spring months, mangel wurzels, if properly kept, may be fed to good advantage. The fowls relish them, and they are easily prepared. As it is not difficult to grow from 10 to 20 tons of these roots per acre, their cost is not excessive. In feeding these beets to flocks of hens, a very good practice is simply to split the root lengthwise with a large knife. The fowls will then

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be able to pick out all of the crisp, fresh food from the exposed cut surface. These large pieces have the advantage over smaller pieces in this respect: The smaller pieces when fed from troughs or dishes, will be thrown into the litter and soiled more or less before being consumed by the fowls, and, in fact, many pieces will become so dirty that they will not, nor should they, be eaten. Large pieces can not be thrown about, and remain clean and fresh until wholly consumed.

"Alfalfa will furnish an abundance of green food. It must, however, be cut frequently, each cutting being made before the stalks become hard or woody.

"Cabbages can be grown cheaply in many localities and make excellent green food so long as they can be kept fresh and crisp. Kale and beet leaves are equally as good and are readily eaten. Sweet apples are also suitable, and, in fact, almost any crisp, fresh, green food can be fed with profit. The green food, in many instances, may be cut fine and fed with the soft food, but, as a rule. it is better to feed separately during the middle of the day, in such quantities that the fowls have about all they can eat at one time."

Wheat furnishes excellent pasture for fowls in this latitude. Sown early, and not pastured until December, it is of great value for this purpose.

GRIT.

"It is necessary that fowls have access to some kind of grit if grain food is fed in any considerable quantities. During the summer months when they have free access to the yards or runs, it will not be necessary to provide grit, providing the soil is at all gravelly. If, on the other hand, the soil is fine sand or clay, it will be necessary not only to provide grit during the winter months, but throughout the whole year.

"Small pieces of crushed stone, flint, or crockery ware will answer the purpose admirably. There are many poultry supply houses which keep constantly on hand crushed granite in various sizes suitable for nearly all kinds of domestic fowls.

"Crushed oyster shells, to a large extent, will supply the necessary material for grinding their food and at the same time furnish lime for the egg shells. Chemical analysis and experiments, together with the reports from many practical poultrymen, show conclusively that the ordinary grain and the green food supplied to

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laying hens do not contain enough lime for the formation of the egg shells. It will require several times as much lime as is ordinarily fed if good, strong egg shells are to be produced. Crushed oyster shells will supply this necessary lime if kept continually before the fowls, trusting to them to eat the amount needed to supply lime rather than mixing the shells with food. The judgment of the fowl can be relied upon in this respect.

MEAT FOOD.

"Where fowls are kept in confinement it will be necessary to supply some meat food. Finely cut fresh bone from the meat markets is one of the best if not the best kind of meat food for laying hens and young chickens. Unfortunately, it is not practicable for many poultrymen to depend wholly on this product, for the reason that it is often inconvenient or impossible to obtain, and when once secured it cannot be kept in warm weather without becoming tainted. Tainted bones should be rejected as unfit for food. Skim milk may be substituted wholly or in part for meat food without a decrease in egg production provided the proper grain ration is given.

FEEDING SMALL CHICKENS.

"Chickens do not require food for the first twelve to thirty-six hours after hatching. One of the best foods that can be fed the first few days is stale bread soaked in milk. This should be crumbled fine and placed where the chickens have free access to it, and where they can not step on it. One of the difficult problems for the amateur poultryman is to devise some means for feeding little chickens so that they can consume all the food without soiling it. If placed on the floor of the brooder or the brooder run, the larger part of the food will be trampled upon and will soon become unfit to eat.

"A simple and efficient feeding trough may be made by tacking a piece of tin about three and a half inches wide along the edge of a half-inch board so that the tin projects about an inch and a half on either side of the board, bending the tin so as to form a shallow trough, and fastening the board to blocks which raise it from one to two inches from the floor. The trough may be from one to three feet long. It is within easy reach of the chickens and so narrow that they cannot stand upon the edges. Food placed in such feeding troughs can be kept clean until wholly consumed.

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"Granulated oats (with the hulls removed) make an excellent food for young chickens. There is, perhaps, no better grain food for young chickens than oats prepared in this manner. It may be fed to good advantage after the second or third day in connection with the bread sopped in milk. A good practice is to keep it before them all the time.

"The chickens should have free access to some kind of grit after the first day. Coarse sand makes an excellent grit for very young chickens. As they get a little older some coarser material must be provided.

"Milk is an excellent food for these young fowls, but requires skill in feeding.

"One of the great difficulties in rearing fowls is to carry young chickens through the first two weeks without bowel disorders, Too low temperature in the brooder, improper food and injudicious feeding, even if the right kinds of food are given, each plays an important part in producing these disorders. After the first ten days milk may be given more freely, perhaps, than during the earlier stages of the chick's existence. As the chick becomes a little older, more uncooked food may be fed. A mixture of fine middlings, wheat bran, a little corn meal, and a little linseed meal mixed with milk makes a valuable food. Hard boiled eggs may be fed from the beginning, but, like milk, require more skill than the feeding of bread sopped in milk. On farms where screenings from the various grains become really a by-product, these form a cheap and efficient food for little chickens. Wheat screenings, especially, form one of the best foods, particularly if they contain a considerable portion of good kernels that have been cracked in threshing. Then, too, the screenings contain a number of weed seeds that have some feeding value and are relished by the fowls. They not only provid sustenance, but give variety, and this, in a measure, improves the general health.

"Drinking fountains require close attention. Small chickens drink frequently and oftentimes with their beaks loaded with food, which is left, to a greater or less extent, in the water supply. As it is necessary to keep these fountains in a tolerably warm atmosphere, they soon become tainted and emit a disagreeable odor. This condition must not be allowed to exist, for all the food and drink consumed by fowls should be wholesome. It has often been said that 'cleanliness is next to godliness,' and certain it is that cleanliness is next to success in poultry keeping. The drinking fountains

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must be kept clean. If automatic fountains are used great care must be exercised in keeping them clean and free from bad odors. Nothing less than frequent scalding with steam or hot water will answer the purpose. A cheap, efficient drinking fountain may be made of a tin can with a small hole in one end near the side of the can, under which is soldered a crescent-shaped piece of tin, forming a lip or a small receptacle for water. If the can is filled with water and then placed on its side, a small quantity of water will run out of the opening and remain in this crescent-shaped lip. As the chicks drink this water a quantity of air will pass into the opening and a little more water will flow out. This kind of fountain will keep before the chickens a small quantity of water at all times accessible. By exercising care and keeping the fountain thoroughly clean, satisfactory results are easily obtained from this arrangement.

BROODERS.

"If one resorts to artificial incubation it will be necessary to provide a brooder of some kind. It may be simple and quite inexpensive, or complex and costly. It is not necessary to expend very much money in the construction of an efficient brooder. It is necessary, however, to see that the brooder is capable of doing certain things. Some of these requisites are summed up in the following: It must be warm. The little chickens require a temperature of from 90 to 100 degrees the first few days, and at all times they should find it so warm in the brooder that they are not inclined to huddle together to keep warm. If the brooder is automatic, then the temperature may be kept quite even throughout the whole floor space. If, on the other hand, the brooder is heated from one side or from the top, and is not automatic, it will be best to construct it so that certain parts of the machine will be very warm, in fact, a little warmer than is necessary for the chickens, and some other part somewhat too cool. It does not take them long to learn just where the most comfortable position is. They may be trusted entirely to select the proper temperature if the brooder is of sufficient size so that it is never crowded. A brooder constructed on this plan will require less attention than almost any other. It may undergo a considerable variation in temperature without overheating or chilling the chickens.

"The brooder should be easily cleaned and so constructed that all of the floor space can readily be seen. Inconvient corners are objectionable in brooders, in fact, any corner is objectionable, but

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if brooders are constructed cheaply, it is almost necessary to make more or less corners. If constructed of wood, circular ones are somewhat more expensive than square or rectangular ones. The floor must not only be kept clean but dry.

"Top or side heat is to be preferred to bottom heat, but there must be sufficient bottom heat to keep the floor dry.

"As the chicken gets a few days old, plenty of exercise must be provided. One objection to many of the brooders in the market is that the chickens are kept too closely confined and not allowed sufficient exercise. It will be a matter of surprise to many to learn how much exercise these little fellows require. With the young chicken, as with the athlete, strength is acquired by exercise, and above all other conditions of growth, strength is the one thing necessary in the young chicken.

INCUBATORS.

"The modern improvement in incubators has made the rearing of fowls solely for egg production quite out of the question unless these machines are used. No experienced poultryman at the present time will undertake to rear fowls in large numbers for the production of eggs and depend on the hens that lay the eggs for incubation. The Mediterranean fowls can not be depended upon for natural incubation. Artificial incubation must be resorted to if these fowls are to be reared in considerable numbers.

"There are many kinds of excellent incubators on the market. As with many kinds of farm machinery, it is impossible to say that one particular kind is better than all others. Then, too, an incubator that would give very satisfactory results with one individual might prove to be quite inferior in the hands of another person, What is best for one is not necessarily best for another. It is advisable, before investing extensively in any make of incubator, to thoroughly understand the machine. If good results are obtained, then additional machines of the same kind should be purchased. Failures are recorded simply because the individual fails to thoroughly understand the machine he is trying to operate, or, in other words, fails to learn how to operate that particular machine to the best advantage. A successful poultryman must necessarily pay close attention to petty details. Not only is this necessary in caring for little chickens and mature fowls, but also in the care and management of incubators and brooders. The whole business is one of details. While incubators may vary considerably one from

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another, yet there are certain points to which all should conform. Some of these points are summed up in the following:

(1) They should be well made of well-seasoned lumber. The effort of manufacturers to meet a popular demand for cheap machines has placed on the market incubators that are not only cheaply made, but made of cheap and not thoroughly seasoned material.

(2) The incubator should be easy of operation. All its adjustments should be easily made and so arranged that the more delicate machinery is in plain view of the operator. The machine should be automatic in operation. When supplied with the necessary heat it should control perfectly within certain limits the temperature of the egg chamber. This result is accomplished in various ways. The regulating force, whatever it may be, should be placed within the egg chamber so that the regulator may vary as the temperature in the egg chamber varies, irrespective of the changes of temperature of the room in which the incubator is placed. The regulator must be sensitive. The change of temperature which is necessary for the complete working of the regulator ought not to be more than 1 degree; that is, 1 degree above or below the desired temperature. It is better if the range of temperature can be reduced to one-half of 1 degree, thus making a total variation of 1 degree instead of 2 degrees.

"It should not be inferred that a much wider variation than this will not give excellent results under otherwise favorable conditions, but, other things being equal, those machines which are most nearly automatic are to be preferred.

"In addition to the foregoing requisites, a convenient appliance for turning the eggs, positive in its action, should accompany each incubator. This may be an extra tray that is to be placed bottom side up over the tray of eggs and held firmly in this position while both trays are turned, thus completely transferring the eggs from one tray to another without jar. The different machines have very different appliances for accomplishing this result. Excellent results are obtained by the use of many machines now on the market when the operator of these various machines is thoroughly interested. Poultrymen have, for a term of years, hatched in incubators over 80 per cent of all eggs put in the machine. It must not be inferred that this is an easy thing to do. A record of this kind is attained only by close observation and good judgment, not only in running the machine, but also in the breeding and care of the fowls to produce fertile eggs.

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DISEASE AND LICE.

"Disease and lice are the great obstacles to be overcome in poultry raising. The houses may be kept free from lice by a liberal use of kerosene emulsion and by whitewashing. Whitewash serves a double purpose, that of ridding the house of lice and making the interior much lighter. A small window, with the interior of the house whitewashed, will make the building as light as a much larger window without the whitewash. If the poultry houses are kept free from lice, the fowls can usually be depended upon to keep themselves free by a liberal use of the dust bath. If, however, body lice are found, they may be successfully treated by dusting insect powder under the feathers in the evening and allowing the fowls to remain undisturbed on the perches after the treatment.

"*Gapes* in chickens frequently destroy large numbers, and are caused by trematode worms in the windpipe. The number of worms is sometimes so great as to completely choke the fowl. A feather moistened with turpentine or kerosene oil and inserted into the windpipe and turned until the worms are removed is a practice quite largely recommended. Others recommend removing the worm with a fine wire or horsehair, doubled so as to form a loup; this is to be inserted into the windpipe and turned until the worms are detached, and then withdrawn, bringing the worm with it. Another remedy practiced by some poultrymen is to cause the chickens to breathe air in a confined space into which fine, slaked lime is occasionally dusted.

"Preventive measures are far more satisfactory than the treatment of infected fowls. The pens and yards should be kept clean and dry and the chickens kept in as thrifty condition as possible by supplying proper food and exercise. While these conditions may not insure absolute freedom from the disease in every instance, yet to moisture and filth can be attributed nearly all cases of gapes, particularly if the yard or pens were previously occupied by infected birds. Yards that have been allowed to become damp, filthy, and infected with the gape-worm may be improved by draining and thorough cultivation. Heavy applications of lime just before cultivating or saturation of the soil with strong salt solution (provided no crop is to be grown) are recommended by experienced poultrymen.

"*Chicken Cholera.*—This is an exceedingly fatal contagious disease, which is widely distributed over this country, and

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causes enormous annual losses, especially in the central and southern sections.

"The first symptom of the disease is, in the majority of cases a yellow coloration of that part of the excrement which is usually white, quickly followed by violent diarrhea and rise of temperature. Other common accompanying symptoms are drooping of the wings, stupor, lessened appetite, and excessive thirst. Since the disease is due to a specific germ, it can only be introduced into a flock by direct importation of this germ, generally by fowls from infected premises. As soon as the symptoms of the disease are observed the fowls should be separated as much as posible and given restricted quarters, where they may be observed and where disinfectants can be freely used. As soon as the peculiar diarrhea is noticed with any of the fowls, the birds of that lot should be changed to fresh ground and the sick ones killed. The infected excrement should be carefully scraped up and burned, and the inclosure in which it has been thoroughly disinfected with a one-half per cent solution of sulphuric acid or a 1 per cent solution of carbolic acid, which may be applied with an ordinary watering pot. Dead birds should be burned or deeply buried at a distance from the grounds frequented by the fowls.

"The germs of the disease are taken into the system only by the mouth, and for this reason the watering troughs and feeding places must be kept thoroughly free from them by frequent disinfection with one of the solutions mentioned.

"Treatment of sick birds is not to be recommended under any circumstances. The malady runs its course, as a rule, in one, two, or three days, and it can only be checked with great difficulty."

"*Roup* is one of the most dreaded of diseases. It is sometimes spoken of as the winter disease. The symptoms are hoarse breathing, swelled eyes, discharge at the nostrils, and sometimes a fetid breath. Treatment is not generally satisfactory. The affected birds should be removed, the houses cleansed and disinfected. Damp, foul air and cold drafts in the poultry houses should be carefully avoided whenever fowls are subject to roup. A decrease in the proportion of corn and an increase in the proportion of meat food in the daily ration is held by some to be highly beneficial in warding off this disease.

"In general, the treatment of the common diseases of fowls is not so satisfactory as preventive measures. Nowhere more than in

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the poultry business does that old adage appply, 'An ounce of prevention is worth a pound of cure.'

DRESSING AND SHIPPING.

"A considerable proportion of the dressed poultry consigned to commission houses in large cities brings to the producer a much smaller profit than it would had the same poultry been dressed and packed for shipment with greater skill. It is of prime importance that the poultry products be placed on the market in a condition that will make them appear as inviting as possible. Proper feeding for two or three weeks before the fowls are slaughtered will improve their color materially. In most of the American markets fat fowls with a yellow skin bring the highest price. This condition may be secured most cheaply by feeding a grain ration composed largely of corn for two or three weeks before the fowls are slaughtered. Of the more common grain foods there is none that excels corn for this purpose.

"The commission men and shippers, who study in detail dressing and packing, state that uniformly fine quality will soon acquire a reputation among buyers. The shipper should always be careful to have the product look as neat as possible. In some of the large cities ordinances prohibit the sale of dressed poultry with food in their crops. In a few instances the sale of live poultry in coops which contain food is also prohibited. In all cases it is best to withhold food from twelve to twenty-four hours before killing, but the fowls should have plenty of water during this time, that they may be able to digest and assimilate food already consumed. All fowls should be killed by cutting through the roof of the mouth and allowing them to bleed to death. In all operations of dressing avoid cutting or bruising the skin or breaking bones. Care is required in the case of the heavy fowls in picking and handling to prevent bruising the skin. In packing fowls use neat, clean, and as light packages as will carry safely. Boxes or barrels holding about two hundred pounds meet these requirements best; boxes are better for turkeys and geese and barrels for chickens. Barrels may be used, however, for dry shipment as well as for hot weather shipment when the fowls are to be packed in ice.

"In shipping live poultry the coop should be high enough to allow the fowls to stand upright without bending their legs. When large coops are used there should be partitions, so that if the coops are tipped all the fowls are not thrown to one side. They

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should have plenty of room in the coop. If possible put only one kind in a coop or in one division of a coop."

(Much of the foregoing may not be practicable on many Oklahoma farms, but the general outlines of poultry management given are worthy of careful study. As a general rule, the custom is to give poultry the "run of the farm" and it is most profitable to keep only one variety of chickens. If it is not possible to build a poultry house similar to that described, some sort of shelter should be provided. A small pen of poultry netting surrounding a box covered with corn or Kafir fodder furnishes warm and safe shelter during cold weather. On a larger scale, a shed may be constructed in a similar manner. Anything that essentially complies with the requirements of cleanliness and warmth will answer the purpose. The farm orchard may be enclosed with netting, with the poultry house at a convenient point. The soil may be sown to pasture crops for the chickens. Wheat is well suited for this purpose during the greater part of the year. Insects will supply animal food and waste food can be utilized at other times. A stack of Kafir fodder will furnish exercise and feed for the chickens during the many bright days of winter. Oklahoma offers a wealth of possibilities of success with farm poultry and the industry should be extensively developed. John Fields.)

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ANNUAL PRECIPITATION.

The following table, showing the annual precipitation in inches at all stations in Oklahoma and Indian territories where the complete record for one or more years has been kept, was prepared from data furnished by Mr. C. M. Strong, Section Director, U. S. Weather Bureau, Oklahoma City, Okla. The distribution of this rainfall by months is shown in the following summary, which includes all years except 1900:

FALL AND WINTER RAINFALL.

AVERAGE OF NINETEEN STATIONS.

October	November	December	January	February	March	Total
2.64	2.02	2.09	1.79	1.12	2.11	11.77

SPRING AND SUMMER RAINFALL.

AVERAGE OF NINETEEN STATIONS.

April	May	June	July	August	September	Total
2.92	4.98	3.84	4.50	2.53	2.27	20.99

Of a total average rainfall of 32.76 inches, 20.99 inches or nearly 65 per cent fell during the months from April to September inclusive.

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ANNUAL PRECIPITATION, OKLAHOMA AND INDIAN TERRITORIES.

STATION	COUNTY	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	Av'ge
Arapahoe	uster						21 47	31 03	25 19	26 69	35 64	28 92	29 36	28 33
Beaver	Beaver								11 84			21 03	16 69	16 52
Blackburn	Osage Nation												47 85	47 85
Burnett	Pattawatomie				45 84	27 75	25 10	36 17	26 08	33 47	43 20	34 36	29 91	33 54
Clifton	Lincoln						22 29	38 19	19 43	32 69	38 75			30 27
Ft. Reno	Canadian	31 91	28 79	26 77	33 51	29 -0	18 28	22 78	19 13	25 56			37 12	27 32
Ft. Sill	Kiowa & Com'che	29 29	31 08	32 76	34 32	24 19	24 08	29 17	17 12	26 29	37 35	46 51	36 47	30 72
Hennessey	Kingfisher										37 73	35 19	29 89	34 27
Jefferson	Grant						17 69	21 56	26 01	29 70	38 54		27 81	26 88
Jenkins	Woods										28 26	30 61	28 42	29 09
Kingfisher	Kingfisher										39 73	34 45	30 56	34 91
Mangum	Greer					11 39	19 52	32 89	22 85	22 49	30 91			28 34
Newkirk	Kay												26 06	26 06
Norman	Cleveland							34 78	23 80	31 24			37 11	31 78
Pawhuska	Osage Nation										54 24	57 96		56 10
Perry	Noble											34 48		34 48
Prudence	Woods								30 97		32 24		23 78	29 00
Sac & Fox Ag'cy	Lincoln								25 95				35 17	30 56
Stillwater	Payne									31 38	42 62	32 87	29 98	34 21
Vittum	Logan						22 99	30 69	31 71			32 62	29 83	29 57
Waukomis	Garfield										29 20	31 29	28 81	29 77
Oklahoma City	Oklahoma			37 43	42 29	24 28	26 72	32 49	21 90	28 47	35 88	43 66	31 45	32 46

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SYMPTOMATIC ANTHRAX OR BLACKLEG.

L. L. Lewis.

GENERAL STATEMENT. In bulletin number 27 of the Oklahoma Experiment Station, published in June, 1897, will be found a short article giving a brief description of blackleg, and since that time several articles have been published with the idea of giving those interested a knowledge of the general nature of the disease. So far as possible the use of technical terms has been avoided and only such descriptions used as would enable any one to recognize the disease and understand the best methods of dealing with it. The extensive loss from blackleg in Oklahoma is sufficient to warrant every effort possible to secure the general use of preventive remedies and to give all the information possible in regard to the disease.

The laboratory work which has been taken up during the year in connection with the manufacture and distribution of the vaccine was undertaken after carefully considering the conditions existing in the territory and the necessity for the general use of some preventive remedy. Considerable assistance has been rendered by G. W. Stiles, assistant in zoology and veterinary medicine, in preparing and testing the vaccine before it was distributed among stock owners. The laboratory work consists in reducing the virulence of the germs to such a degree that when inoculated into a healthy animal they will produce a very mild form of the disease which will confer immunity. After the vaccine is made its strength is determined by testing on rabbits or calves before any of it is sent out for general use.

MEANS OF PREVENTION.

Symptomatic anthrax, or blackleg as it is more commonly called, is known in different localities under the names of black quarter, quarter evil or cold gangrene and is the most common of all diseases among young cattle. The disease has been recognized for a great many years but the exact cause and nature of blackleg has been understood only a short time. The actual cause

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was not discovered until 1879 when the disease was proven to be different from Anthrax. French bacteriologists discovered the germ and produced the disease experimentally in the ox, sheep and goat by inoculating them with the blood from the tumor which is always found associated with blackleg. The work of Arloing, Cornevin and Thomas, published at Paris in 1887, forms the basis of all recent work in this connection and the method of preventive inoculation which they perfected is used in a modified form at the present time.

In Oklahoma blackleg seems to be especially prevalent at certain seasons of the year and on this account the Experiment Station undertook the manufacture and distribution of a vaccine, not only to stop the immediate loss from the disease, but if possible, to secure the general use of a reliable means of prevention. The efficiency of vaccine in preventing outbreaks of blackleg and stopping the loss in herds where it already existed is beginning to be appreciated. No reports have been asked for from the users of the vaccine but many letters are being received recommending the use of the vaccine and asking for more of the material. The use of the single vaccine has been an important item in securing the general introduction of vaccine. On large ranches the labor ad inconvenience of having to handle large numbers of wild animals a second time would necessarily prevent many using the vaccine. All of the vaccine sent out is what is known as the single vaccine, it is easily prepared for injection and requires the handling of cattle only once. Every lot of vaccine is carefully tested before being sent out and the full dose is calculated for cattle over six months old. The dose is as large as can be safely given and some loss will likely occur if an overdose is given while less than the correct amount will not give sufficient protection.

There are very few diseases with which the stockmen and farmer are so familiar as they are with blackleg; its general distribution, the class of cattle affected and well marked symptoms combine to make it one of the easiest recognized. In most cases all fail to recognize the fact that it is an infectious disease and that the infection will live for years when it is once established on a farm or ranch. Blackleg is a true infectious disease and if all would recognize this fact there would be a greater effort made to dispose of the dead animals in such a way as would not scatter the infection over the entire farm. Cattle may become infected by the germ entering the body through wounds of the skin or mucous

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membrane. In controlling outbreaks of the disease it is well to know that animals contract the disease from pastures, or hay from infected land and that the most important source of infection is from bodies of dead animals. The disease is not contagious and under normal conditions it is never contracted by an animal from one that is sick. The germ must enter through a wound in the skin or mucous membrane and Hess thinks the disease is often caused by the germ entering through wounds in the mouth during the time the animal is cutting or shedding teeth.

In any outbreak of a contagious or infectious disease among cattle there are certain conditions existing that will render the animal more susceptible but these conditions are never the cause of the disease. Usually such conditions as predispose to disease are those lessening the vitality and physical condition of the animal, but in blackleg the opposite is true. Young cattle when gaining rapidly in flesh are more susceptible than those poor in flesh, but the disease is caused by a germ or bacteria and the cattle are only rendered more susceptible to the germ by these conditions. The fact that the disease is more common during the fall and spring, at a time when conditions are favorable for fattening has led many to believe that these conditions are the cause, and this common, but erroneous, belief has prevented in many cases the introduction of vaccine.

Experience has demonstrated that one attack of blackleg confers immunity in all cases. Immunity obtained in this way is spoken of as acquired immunity as distinguished from natural immunity which means that an animal will not have a given disease. Blackleg is easily inoculated in the ox, goat, sheep and guinea pig. The pig, dog, cat, and rabbit seem to possess a natural immunity from the disease. Man is also immune to the disease. Inoculation of the virus in the horse or donkey produces only a local reaction.

Blackleg is found to some extent in nearly all countries of the world. Temperature and altitude do not seem to be very important factors in limiting the disease, as in certain countries of the north and in the mountains of Switzerland the disease is as common as in the lowlands. The occurrence of blackleg in localities where the ground is covered with snow for several months of the year shows the wonderful resistance of the germ. The germ has the power of forming spores which is a more resistant state of the germ and the germ may remain virulent in this condition for several years. In France the disease is very common among young stock and this fact

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probably stimulated the French scientists to perfect some means of prevention. In the United States the disease is widely distributed but it is only in certain states and territories that it causes any considerable loss. Very little loss is reported from east of the Mississippi river and in some of the Atlantic and Gulf states it has not been reported at all. In the report of the Bureau of Animal Industry which is based on an extensive investigation of the disease, it was found that Texas, Kansas, Nebraska, South Dakota, Colorado, North Dakota, Oklahoma and Indian Territories comprised the region where the greater portion of the vaccine was used. In the states and territories named the percentage of infected counties was found to be from 46 in Texas to 80 per cent. in Oklahoma and Indian Territories. From applications received by the experiment station it is evident that the disease exists in every county in Oklahoma but is more prevalent in the southern and western counties.

Cattle over three years of age are practically immune to blackleg, while younger and rapidly growing animals are very susceptible. The greater number of cases occur between the ages of 6 months and 2 years but occasionally cases are reported in younger or older animals. In some reports of outbreaks statements are made that calves under six months old are immune but this does not agree with observations made in Oklahoma, as a number of cases have been observed that were less than six months old and one case that was less than two months old. Range cattle are not as susceptible as well bred animals and this may explain the fact that in herds where the breed has been improved blackleg is more common than formerly. As the grade of stock is improved by crossing with well bred animals, blackleg will become more common, as this seems to lessen the power of resistance to this particular disease. This will necessitate the use of vaccine to a greater extent in order to prevent an increased loss.

The symptoms of the disease are both general and local and are so well marked that there need be no mistake made in recognizing the trouble. The general symptoms are loss of appetite, dullness and high fever. They are not essentially different from those of other acute infectious diseases. Within a very short time after the general symptoms appear, swellings can be seen on the limbs, head or neck. These tumors are at first hot and painful, but spread rapidly and soon become filled with gas, this maybe determined by passing the hand over the swelling when a crackling sound is heard.

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After the gas begins to form in the tumor they are not sensitive to the touch and the skin soon becomes cool and dry over the center. Incision of the tumor causes no pain but allows the escape of a dark red liquid which has a disagreeable and acid odor. The course of the disease varies. Ordinarily the animal dies in from 12 to 24 hours after the first symptoms are noticed. This time varies however and especially when older cattle are attacked; in this case the disease is usually in a mild form and the animal may recover.

Ordinarily there is no necessity for cutting into the animal and under no condition should the skin be removed as there is no surer means of scattering the infection. The most satisfactory means of disposing of the carcass is to burn it but when this is impossible the body should be buried at least four feet deep so none of it may be brought to the surface by other animals.

The germ of blackleg is a small rod shaped body averaging about one three thousandths of an inch in length. They are always found in large numbers in the black meat and clotted blood under the skin and are in large numbers in all of the fluids of the body soon after death. The germ will not grow in the presence of oxygen and the growth is always accompanied by the production of gas; it produces spores and on this account is one of the most difficult germs to destroy of all the infectious diseases. Numerous experiments have been conducted to determine the time the germ will live and to determine the action of disinfectants. The spores will live for years in the soil as they are not affected by the cold, they require a temperature 110 degrees centigrade for six hours or the action of boiling water for two hours to kill them. Before the germ has formed spores it is easier killed, but spores are formed soon after the death of the animal and any part of the body that may be carried by buzzards, crows or dogs to different parts of the farm is a certain means of scattering infection that will be a source of danger for years.

Preventive inoculation against blackleg has assumed a special scientific and economic importance during the last few years. Preventive inoculation has been practiced in this country for several years but only within the last five years has the practice become general. This has been brought about by the free distribution of vaccine by the Bureau of Animal Industry and some of the experiment stations located in the states and territories where cattle raising is an important industry. The Oklahoma Experiment Station has sent out 58,950 doses of vaccine since March first, 1900.

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This material was distributed free of any charge to every stockman and farmer who made application for the vaccine. Requests have been received from every county in the territory and a considerable amount has been sent to stockmen in the Indian Territory.

Cattle may be vaccinated at any time of the year and should be vaccinated at least twice between the ages of six months and two years. If calves under six months old are vaccinated they should be vaccinated again as soon as they pass this age, as vaccination at such an early age does not confer immunity to the same degree as when vaccinated later. If cattle are vaccinated twice as recommended, the loss would be reduced to a minimum, and after years of such work the amount of infection would be lessened to such a degree that the necessity for vaccination would not be so great as it is at the present time.

TREATMENT.

It is well to say at the beginning that there is no curative treatment for animals that are affected with blackleg. As stated before it is a rare occurrence for animals affected with this disease to recover but if they do recover they are immune to subsequent attacks. There are various methods of treatment in vogue among stockmen for this disease. One of the most popular remedies is to bleed from the jugular vein or to cut open the tumor and inject strong solution of such antiseptics as carbolic acid or creolin. Some of these remedies are used as a means of preventing the disease, especially bleeding and nerving. The later consists in cutting into the back part of the foot and usually cutting a small artery in this region. Roweling is a favorite remedy and is practiced in many parts of the territory. This operation consists in introducing under the skin some foreign substance such as leather, pieces of rope or poke root, in fact any thing that will produce suppuration and cause a running sore. When the nature of the disease is understood the uselessness of such methods will be seen. The general practice of such methods is due to the fact that when an animal is sick the owner must do something, and if the disease is likely to attack others of the herd such methods as named above are likely to be put into operation. Cutting and wounding the animal in nerving, roweling, etc., only increases the chances of infection through the wounds and amounts to nothing as a cure or a preventive. The Experiment Station has no remedies to recommend as a cure as the disease is acute and almost invariably fatal. If a remedy could be

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found that would cure 50 per cent of the cases it would be no argument for its use to the exclusion of vaccination. Statistics show that the loss before vaccination is above three and one half per cent, while after vaccination it is less than one half per cent.

VACCINATION.

There is considerable interest attached to the history and development of vaccination in this particular disease as it illustrates what may be done in the way of preventing a disease when almost every remedy imaginable has been tried as a cure. The manufacture of vaccines for other diseases as well as for blackleg is a branch of preventive medicine that has been developed within the last few years and every new vaccine added to the list clearly demonstrates the fact that preventive remedies are cheaper than any remedy that will cure a large per cent. of the sick animals. In 1879 Arloing and Thomas discovered the germ of symptomatic anthrax and soon afterwards succeeded in producing immunity by injecting under the skin a small amount of attentuated virus of the disease. The black muscle from the tumor caused by the germ is used in making the vaccine. This is dried and pulverized and then made into a paste after which it is heated for several hours at a high temperature which weakens the virulence of the germ. The powder obtained by treating the meat in this particular way is what is used for vaccination.

The vaccine sent out from the station is prepared in the laboratory of the Veterinary Department and is sent out in ten and twenty-five dose packages. The vaccine is made in lots of from five to eight thousand doses and a separate record kept of each lot. A few complaints have been made that the vaccine did not stop the loss or that occasionally an animal appeared to die from the vaccination. Carelessness in vaccinating is almost invariably the cause of the trouble as the same lot of vaccine is sent to other parties who make no complaint. There are several little details easily overlooked that may materially affect the results. This will apply particularly to filtering the fluid and to keeping the vaccine fluid well shaken up while it is being used.

To properly adminster the vaccine a vaccinating outfit of some kind is necessary. This consists essentially of a good heavy hypodermic syringe and needles. Other pieces of apparatus accompany the syringe and are used in preparing the vaccine for injection. The syringe should be kept clean and in good shape for

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vaccinating as there is no difficulty in injecting the correct amount while if the syringe is not in good working order there is no certain-

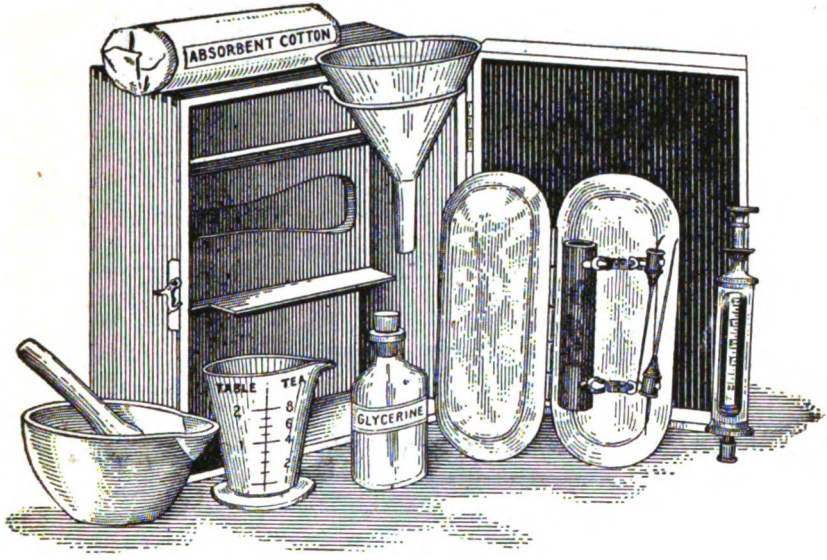

FIGURE 1. VACCINATING OUTFIT.

ty in the amount given consequently no dependence to be placed in the work.

The preparation of the vaccine for injection requires very little time or skill. The following printed directions for the preparation and use of the vaccine were sent out with every lot of vaccine furnished by the station.

Before the vaccine is prepared all of the utensils including the syringe must be sterilized. Place every thing used in the process of vaccination in cold water and boil for ten minutes. After boiling remove from the water and dry with a clean cloth that has been boiled. Place the vaccine in the porcelain mortar and moisten with a few drops of water which has been boiled and allowed to cool. Work the powder with a pestle or glass rod and add slowly as many cubic centimeters of water as you have doses of vaccine. The syringe used for vaccinating purposes holds five cubic centimeters and may be used for measuring the water. After the water is added the fluid is thoroughly stirred so as to get as much of the vaccine in solution as possible. To filter the vaccine place in the funnel a small piece of absorbent cotton and press down in the

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funnel and moisten with a few drops of water and let it drip off. Stir the mixture of water and vaccine thoroughly and before it has had time to settle pour it into the funnel under which you have placed the measuring glass. The fluid should not come through clear but

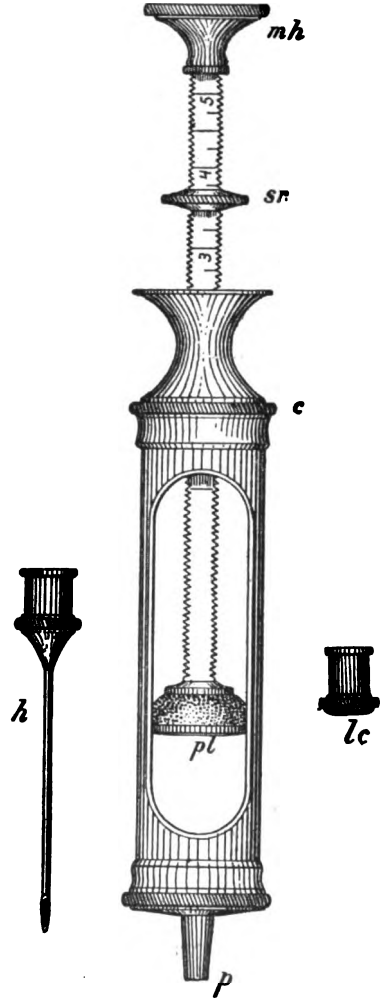

FIGURE 2. HYPODERMIC SYRINGE.

should be cloudy, and if it is clear the layer of cotton in the funnel is too thick. The object of filtering is to get out the coarser parti-

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cles and prevent the needle of the syringe from clogging when the vaccine is injected.

When possible the vaccine should be prepared at home and carried to the stock lots in a small sterilized bottle from which the vaccine can be drawn with a syringe. If the vaccine is allowed to stand for a short time a sediment will form at the bottom of the vessel or bottle, therefore the fluid should be well shaken before the syringe is filled. No more vaccine should be prepared than is to be used the same day as it will not keep in solution.

The syringe holds five cubic centimeters (five doses) and the piston is graduated from one to five with finer subdivisions between the figures. The regulator on the piston can be placed at any position and the dose varied depending on the age of the cattle. For any animal over six months old the dose is one cubic centimeter and fractional parts of a dose may be given to younger cattle depending on the age and development.

The best place to vaccinate is on the side of the neck or shoulder as the skin is thin in this region. Pass the needle through a fold of the skin and then adjust the peg of the syringe in the needle and inject the dose which has been limited by the regulator on the piston. Withdraw the needle and syringe at once and to prevent any of the vaccine escaping through the opening made by the needle the skin is pressed tightly around the needle as it is withdrawn.

After injection the syringe should be thoroughly washed in a five per cent solution of carbolic acid, carefully dried and the brass wire placed in the needle.

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BEEF-MAKING WITH CORN, KAFIR CORN, AND ALFALFA.

F. C. Burtis.

The second steer feeding experiment in the series planned by this station to compare the feeding value of corn meal and Kafir meal fed with alfalfa hay and Kafir stover, was completed April 6th, 1901. The following is a summary of the results which may be compared with those of previous experiments published in the annual report for 1899-1900.

The past winter's experiment was practically a duplicate of the one carried on the preceding winter.

The steers used in this experiment were grade Short-horns with the exception of one grade Hereford. They were raised in this locality and were three years old the spring of 1901, and were of very fair quality and in good feeding condition when taken off the grass to be put in the experiment. At the beginning of the experiment, November 6, the twenty head averaged 1026 pounds and on April 6, at the close of the experiment, they averaged 1409 pounds.

The twenty head were divided into four lots of five steers each and fed in yards with open sheds for shelter. The lots were fed as follows for the entire time, 151 days, of the experiment:

Lot I. Kafir meal and alfalfa hay.

Lot II. Corn meal and alfalfa hay.

Lot III. Kafir meal and Kafir stover.

Lot IV. Corn meal and Kafir stover.

The steers had access to good water in tanks and salt in boxes, at all times. The grain was fed twice a day and the roughage once, and all waste weighed back daily. A fairly heavy grain feed was given but not quite all that the steers would eat. All feed fed and

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waste taken out was sampled for moisture determinations and analyses. The steers were weighed weekly.

The following is a summary of the results of the entire feeding period:

DATA FOR 151 DAYS	Lot I. Fed Kafir Meal and Alfalfa	Lot II Fed Corn Meal and Alfalfa	Lot III Fed Kafir Meal and Kafir Stover	Lot IV Fed Corn Meal and Kafir Stover
Gain per lot—lbs	2,052	2,066	1,760	1,785
Daily gain per steer—lbs	2.72	2.73	2.33	2.36
Grain eaten per pound of gain—lbs	7.63	6.63	9.95	9.50
Grain eaten per lot—lbs	15,666	18,711	17,509	16,960
Gain produced per bu. of grain eaten—lbs	7.34	8.44	5.52	5.89
Roughage fed per lot—lbs	14,257	18,604	17,892	17,668
Roughage fed with each bu. of grain—lbs	6.89	6.58	10.15	9.90

The season was favorable and the steers did well and no breaks occurred during the experiments.

ALFALFA VS. KAFIR STOVER.

Comparing first Lots II and IV where cornmeal was fed to both lots; the alfalfa fed steers made 2.55 pounds more beef from each bushel of grain than did the Kafir stover fed steers. The former required 2.15 pounds less of grain per head per day and made .37 of a pound more gain per steer each day than did the stover fed steers.

In the second comparison with Lots I and III where Kafir meal was fed to both lots, the alfalfa fed steers made 1.83 pounds more beef from each bushel of grain eaten than did the steers fed on Kafir stover. The former required 2.44 pounds less of grain per steer per day and made .39 of a pound more daily gain per steer than did the stover fed steers.

KAFIR MEAL VS. CORN MEAL.

In the lots that were fed like roughage the corn meal produced slightly better gains than the Kafir corn, but not enough to be of any practical difference.

In Lots I and II where alfalfa was fed as roughage, the corn meal fed steers ate 2.04 pounds less grain per day per steer and made 1.10 pounds more beef from each bushel of grain than did the Kafir meal fed steers.

In Lots II and IV where Kafir stover was fed as roughage, the corn meal fed steers ate .72 of a pound less grain per head daily,

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and made .37 of a pound more beef from each bushel of grain than did the Kafir meal fed steers.

SUMMARY OF GAINS.

Taking an average of the above results, a bushel of corn meal produced, when fed to steers, about three quarters of a pound more beef than did a bushel of Kafir meal.

In addition to requiring from a fourth to a third less grain to produce a pound of beef, the alfalfa fed steers made about 16 per cent. faster gains than did the Kafir stover fed steers.

PIGS FOLLOWING STEERS.

Four shoats, averaging 125 pounds in weight were put after each lot of steers at the beginning of the experiment. They were good thrifty pigs, about seven months old. The plan was carried out to make these pigs subsist upon the droppings of the steers as much as possible. When they were fed any grain extra it was the same kind that the steers that they were following were getting. For the first ten weeks each lot of pigs was fed four pounds of grain per day. For the next ten weeks each lot was not fed any extra grain. For the last eleven days of the experiment each lot was fed eight pounds of grain per day. The pigs seemed to be very well satisfied even when they were not getting any extra grain, but were on the lookout for something to eat. The gains were not large, but at the close of the experiment, all the pigs were in fair marketable condition for light hogs, but some of the lots were considerably better than others as might be expected from the gains. The following is the gains and grain eaten for the 151 days:

	Gain per Lot, Lbs.	Grain Fed Lbs.	Grain fed per lb. of Gain.
Lot I, (After Kafir meal and Alfalfa steers)	272	360	1.32
Lot II, (After corn meal and Alfalfa steers)	183	360	1.97
Lot III, (After Kafir meal and Kafir stover steers)	410	360	.87
Lot IV, (After corn meal and Kafir stover steers)	226	360	1.58

Undoubtedly better gains could have been obtained with these pigs if more grain had been fed, but the pigs would not have picked the manure over so closely, and it is a question if it would pay to feed more grain.

The difference in gains made by the lots can be accounted for largely by the fact that a much larger per cent. of the grain passed

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through the steers getting Kafir stover than those getting alfalfa. Again, a much larger per cent. of the Kafir meal passed through the steers than did the corn meal.

SALE OF STEERS.

April 10th, the steers were sold on the Kansas City market as follows:

LOT	Per Cent Dressed Out
Lot I, 7010 lbs. at $5.40	60
Lot II, 7000 lbs. at $5.40	60.5
Lot III, 6640 lbs. at $5.10	59.9
Lot IV, 6700 lbs. at $5.20	59.9

In shipping to Kansas City the shrinkage per head was as follows:

Lot I, 35 pounds, Lot II, 33 pounds, Lot III, 51 pounds, Lot IV, 48 pounds.

The cost of marketing the twenty steers was $92.56.

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COTTONSEED MEAL AS PIG FEED.

F. C. Burtis.

INTRODUCTION.

Protein, the nitrogenous part of the feed, is the most important constituent in it. Many of the common feeds on the farm, as corn, Kafir corn, etc., do not contain this ingredient in sufficient amount for the best results in feeding. A feed is generally valuable in proportion to the amount of protein it contains. Cottonseed meal is one of the very richest feeds in protein and it is a very cheap source of this valuable food ingredient. In cattle feeding, cottonseed meal is used quite extensively and with the best results where certain precautions are followed. It has been used only to a limited extent in pig feeding, as fatal results have followed as a rule in the general way of feeding it. After feeding on it from four to six weeks the pigs would commence dying, and this has usually been the case when even very small amounts of the cottonseed meal have been fed along with other grain. The writer has found a mixture of 1-5 cottonseed meal and 4-5 corn or Kafir meal to give most excellent results when fed to pigs, and with very few exceptions no pigs have died, if the cottonseed meal was not continued longer than four weeks. Later experiments at this station indicate that there are several conditions under which pigs may be fed a small amount of cottonseed meal with other grain for an indefinite time without injuring the pigs in any way, and good gains obtained with a small amount of grain. One of the conditions is where the shoats have access to plenty of range and green feed. Again, if the cottonseed meal is dropped after feeding three or four weeks and after a lapse of two or three weeks added to the feed again for three or four weeks, and dropped again for a few weeks, and so on until the pigs are grown or fattened, good gains will be obtained with practically no loss of pigs. Once in a great while there may be exceptions to both of these methods as the following experiments will show. These experiments were planned

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with the view of ascertaining in what ways and under what conditions cottonseed meal may be fed safely to pigs.

TRIAL I, SPRING 1900.

This experiment was planned to test the alternating method where the cottonseed meal was to be fed for a few weeks and then dropped for a few weeks and taken up again, and this process continued until the pigs were finished. This work, as are most of the following experiments, was rather preliminary work for future experiments.

Seventeen thrifty shoats varying more or less in size were used. They were mostly late fall pigs and averaged 80 pounds per head at the beginning of the experiment, March 22nd. They had the run of a large paddock where they could get a little green stuff now and then. For the first 27 days they were fed a grain mixture containing 1-5 cottonseed meal and 4-5 Kafir meal; for the next fourteen days nothing but Kafir meal was fed; for the next fourteen days 1-5 cottonseed meal was added, and then for seven days the cottonseed meal was dropped, and then for five days it was added. This made a total feeding period of sixty-seven days. At the close of this, part of the pigs were sold and the rest put in another experiment which included cottonseed meal as part of the feed. During forty-six days of the sixty-seven, the pigs had received a grain ration containing 1-5 cottonseed meal and none of them had died, and all had made very fair gains and on a moderate amount of grain.

For comparison, the first twenty-seven days in which 1-5 cottonseed meal was in the grain ration, are taken as period I; the twenty-one days in which no cottonseed meal was fed are taken as period II; and the other nineteen days in which 1-5 cottonseed meal was included are taken as period III.

The following are the results:

Period I. Feed; 1-5 cottonseed meal, 4-5 Kafir meal.

Grain required to produce a pound of gain.. ....3.19 lbs.
Daily gain per pig.. .....1.28 lbs.
Cost per pound of gain..... .....1.72 cts.

Period II. Feed; Kafir meal and corn meal.

Grain required to produce a pound of gain.....5.71 lbs.
Daily gain per pig .....1.04 lbs
Cost per pound of gain..... ....2.55 cts.

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Period III. Feed; 1-5 cottonseed meal, 4-5 Kafir meal and corn meal.

Grain required to produce a pound of gain..... .....4.39 lbs.
Daily gain per pig .....1.21 lbs.
Cost per pound of gain.... .....2.37 cts.
(Kafir meal 40 cts. per cwt. Cottonseed meal $1.10 per cwt.)

Close comparisons cannot be made between these periods as they vary in length and all the days are not consecutive. But it can be plainly seen that the pigs made much better gains while receiving the cottonseed meal and required much less grain to produce a pound of pork. None of the pigs died, although they had received cottonseed meal as a part of their ration for forty-six days, twenty-seven of which were consecutive days.

TRIAL II, SPRING 1900.

This experiment was carried on with sixteen shoats. At the beginning of the experiment, April 12, they were the scrawniest, stunted pigs imaginable. Space will not be taken up to explain how this condition was produced. They were about one year old and averaged only 79 lbs. in weight. They were not only poor but small in size and had great large stomachs, caused by the feed they had received previous to this time.

For twenty-six days from April 12, these pigs were fed as follows:

They were hurdled on wheat and fed a light grain ration, consisting of 1-5 cottonseed meal and 4-5 Kafir meal. The following are the results for this period:

Grain consumed..... .....1252 lbs.
Total gain..... .... 402 lbs.
Grain eaten per pound of gain..... ..... 3.11 lbs.
Daily gain per pig..... ..... .96 lbs.

These runts took to their feed and the new conditions readily and made rapid advancement from the start and showed no ill effects of the cottonseed meal. There is no question but that the wheat pasture was a great factor in bringing out these pigs.

At the end of the twenty-six days, May 8th, the sixteen pigs were taken off from the wheat and shut up in a lot and fed the same kind of grain, 1-5 cottonseed meal and 4-5 Kafir meal, for tweny-one days. They continued to flourish and at the end

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of the twenty-one days showed no ill effects of the cottonseed meal. The following are the results:

Grain eaten	1770 lbs.
Total gain	576 lbs.
Grain eaten per pound of gain	3.07 lbs.
Daily gain per pig	1.71 lbs.

All of the pigs were in very fair condition at the close of this period and five of the largest and best were sold. Here was a case where pigs were fed for forty-seven consecutive days on grain consisting of 1-5 cottonseed meal and 4-5 Kafir meal without killing any of the pigs, and all made good gains and on a small amount of grain. Further, the eleven pigs of this lot that were not sold were put in with other pigs where they had range and green feed and fed a grain ration of 1-5 cottonseed meal and 4-5 corn meal, until July 14th, when they were sold. None of these died and all made good gains. This was a case where pigs were fed part cottonseed meal for eighty-four consecutive days without killing the pigs, and good gains were obtained.

As was stated under trial I, at the close of that experiment, part of the pigs were sold and the balance continued on the ration containing cottonseed meal. Out of a feeding period of sixty-seven days these pigs had received a grain ration containing 1-5 cottonseed meal for forty-six days. This grain ration was continued without change until July 14th. Most of the time the pigs had access to pasture. With one exception the pigs continued to do well and were sold as fat hogs July 14th. The exception was a fine thrifty gilt. She had made most excellent gains. On June 18th, she died suddenly and on examination she showed the usual condition that pigs do that have died from eating cottonseed meal. The internal organs are more or less inflamed and congested and the thorax cavity filled with a fluid. This gilt had received the cottonseed meal as a part of her ration twenty-six consecutive days prior to her death, and preceding this period for forty-one days, but not consecutive days.

SUMMARY.

In these trials thirty-three pigs were fed on a grain ration consisting of 1-5 cottonseed meal and 4-5 corn or Kafir meal, for longer or shorter periods.

In one case, seventeen shoats were fed for sixty-seven days, on forty-six of which the grain ration contained the cottonseed meal. These forty-six days were divided up into three periods, the longest

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one being twenty-seven days. All of the pigs lived and made good gains, and at the close of the sixty-seven days, part of the pigs were sold as fat hogs, and the remaining four were continued on the same grain ration. Twenty-one days from this time (after twenty-six consecutive days of cottonseed meal feeding) one of the four died from the effects of the cottonseed meal, as was clearly shown on examination. The one that died was a fine thrifty gilt. The remaining three pigs were continued on the same ration for twenty-six days longer, and then sold as fat hogs. This made forty-seven consecutive days of cottonseed meal feeding for these three, and prior to this time, in a period of sixty-seven days, they were fed on a ration containing 1-5 cottonseed meal for forty-six days, but not consecutive days.

In another case sixteen shoats were fed a ration containing 1-5 cottonseed meal for forty-seven consecutive days, and all lived and made good gains. At the end of this five were sold and the other eleven continued on the same grain ration for forty-seven consecutive days longer, and all the pigs lived and were sold as fat hogs at the end of this time. This made ninety-four consecutive days in which cottonseed meal was a part of the ration, and all the pigs lived and made good gains.

It should be borne in mind that in all these trials, the pigs had range and green feed most of the time. Other experiments with this problem have been completed at this station and others are under way. Some of these have been carried on to determine the comparative feeding value of a ration containing cottonseed meal and corn, with one of exclusive corn, and other mixtures. These and other results will be reported after completing further work.

Our work has gone far enough to enable us to state that excellent gains may be obtained by adding 1-5 cottonseed meal to a pig ration, and that it may be so fed that there is but a small chance of any of the pigs dying from the effects of it. We are not ready yet to say exactly how or under what conditions this should be, but under our methods the death rate was so small that the gain from feeding the cottonseed meal greatly over balanced it.

These directions might be followed by those who want to try feeding pigs on cottonseed meal:

Don't add more than 1-5 cottonseed meal to the ration.

Feed rather a light ration.

After feeding the ration containing the cottonseed meal for

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three weeks, drop the cottonseed meal for two or three weeks, then put it in for three weeks, then drop it for two or three weeks, and so on.

Endeavor to let the pigs have range and green feed at the same time.

Report results to the experiment station.

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COWPEA HAY FOR SWINE.

F. C. Burtis.

A series of experiments has been under way at this station to ascertain the value of cowpea hay as a source of protein, and to give bulk to the ration, in pig feeding. The cured hay has been fed along with a ration of grain to certain lots of hogs in comparison with others fed exclusively on a grain ration.

The up-to-date hog raiser realizes the importance of furnishing sufficient bulk in the ration as well as the proper amount of protein. The pig is naturally an omnivorous feeder and if he is compelled to subsist exclusively on a grain ration of any of our common cereals, his health will suffer and he will not make a proper, nor the most profitable, development. It is true that most of our common farm crops do not contain enough protein for the best development of a pig, but this lack may be overcome by the addition of some feed that is rich in protein, and still the pigs will fail to make the most rapid development if the ration does not contain a certain amount of bulk that is necessary for healthy, vigorous digestive action. With the properly planned hog range, that contains along with the other green crops, some such a crop as cowpeas, alfalfa, or clover (green crops rich in protein), the problem is easily solved and very economically. But some seem to find it necessary to shut pigs in small pens and very often feed them nothing but corn or Kafir corn. With mature hogs that are to be fattened only a few weeks this will be all right, but with the growing shoats or breeding stock, if some feed is not added to furnish protein and bulk to the ration, the stock will do very poorly. Several feeds could be added to such a ration that would correct the evil and the question under consideration is to what extent would cowpeas hay do this. The value of green clover, alfalfa, and cowpeas as pig feed is pretty well known, but as yet little attention has been called to the value of these crops in the dry condition, hay, for pig feeding. Clover hay has been used for this purpose for a good many years by some, and in the experiments, pigs receiving clover hay with cornmeal have made thirty per cent better gains than pigs receiving an exclusive cornmeal ration.

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Other experiments have demonstrated that pigs fed alfalfa hay along with corn or Kafir corn, make much better gains and require much less grain to produce a pound of gain than a pig fed on corn or Kafir corn only. Cowpea hay is about as rich in protein as alfalfa hay and is eaten by pigs confined in pens, and should give about the same results as clover or alfalfa hay.

To test the value of cowpea hay along this line, the following experiments were planned and carried out:

TRIAL I.

This experiment was carried on during the winter of 1899-1900. The stock used was grade Poland-China, and were purchased for this experiment of a local hog buyer. They were not at all thrifty and were lean and lank. The bunch included gilts and barrows. They were probably about eight months old and averaged about 115 pounds at the beginning of the experiment. They were divided into two lots of four pigs each and were put in pens a couple of rods square, where they were kept during the experiment. Lot 2 was put on an exclusive grain ration, that consisted of ½ cornmeal and ½ Kafir meal. Lot 1 was fed from the same grain ration but was given all the cowpea hay they would eat in addition. The hay was fed just as it came from the stack, without any preparation, in a rack, in one side of the pens, so that the pigs could pick it over. A liberal amount, 8 to 10 pounds, was fed per day to the lot. From one-third to one-half of this was eaten up. The stems were eaten about as much as the leaves. The hay was of rather a poor quality but the pigs were always ready for it. Each lot was fed all the grain it could eat up clean. Wood ashes and salt were kept in the pens at all times.

The experiment began January 23rd, and closed April 3rd, making a period of ten weeks. The following are the results:

	Lot I Lbs.	Lot II Lbs.
Grain eaten per lot	1,203	751
Hay fed per lot	589	
Total gain per lot	270	108
Daily gain per pig	1.09	.43
Grain eaten per lb. of gain	4 46	6 95
Cowpea hay fed per lb. of gain	2.18	

At the close of the experiment Lot I was in a fair marketable condition but Lot II was not in as good condition.

The better appetite of Lot I was very noticeable all through the experiment. Lot I, the one that received the cowpea hay, made

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150 per cent better gain than Lot II, and required two and one half pounds less of grain to produce each pound of pork than Lot II did. While the pigs fed cowpea hay with their grain made a very favorable showing over those fed only grain, the results were not as would justify shutting the pigs up in pens to be fed in that way if good wheat pasture was available. In studying these results the fact must be kept in mind that these shoats were fairly well grown at the beginning of the experiment, but were not in a thrifty condition.

TRIAL II.

This experiment was carried on during the winter of 1900-1901. The stock used was twelve grade Poland-China pigs, raised on the sation farm. They were late fall pigs and in a good thrifty condition at the beginning of the experiment, at which time they averaged 61 lbs.

They were divided ino two lots of six pigs each and put in the pens that were used in the previous experiment. The treatment was practically the same as in the previous experiment. Lot I was fed grain and cowpea hay, Lot II grain only. As before, the grain consisted of ½ cornmeal and ½ Kafir meal. Each lot was fed all the grain it would clean up. The cowpea hay was fed as before. The quality was very fair and about half the amount fed, 7 to 10 pounds per day, was eaten. Both lots were kept well supplied with water, charcoal, wood ashes, and salt.

The experiment extended over a period of ten weeks, December 12th to March 1st. The following are the results:

	Lot I Lbs.	Lot II Lbs
Grain eaten per lot	1,372	1,174
Cowpea hay eaten per lot	359	
Total gain per lot	191	119
Daily gain per pig	.46	.24
Grain eaten per pound of gain	7.1	9.8
Cowpea hay eaten per pound of gain	1.87	

For the first few weeks both lots ate practically the same amount of grain, but gradually Lot II fell behind and was still losing ground at the close of the experiment. From the start neither lot seemed to be satisfied and did not do real well, but Lot I was more contented than Lot II and generally made better gain. The cowpea hay was always eaten with quite a relish. At the close of the experiment neither lot was making any gain to speak of but

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Lot I was doing a little the better. It was evident that a change of condition was necessary to finish the pigs with profit. In judging the results the fact should be kept in mind that the pigs were quite young and kept under confinement. Lot I, which was fed the cowpea hay made sixty per cent better gains than the lot not fed cowpea hay and required 2.7 pounds less grain to produce each pound of pork.

SUMMARY.

The first experiment would indicate that shoats about eight months old could be put in pens and fattened on corn and Kafir corn with the addition of cowpea hay, in a fairly profitable manner and with much better success than pigs under like conditions without the cowpea hay. But the results would not justify abandoning a good range and plenty of green feed.

The second experiment furnishes further evidence that it is not profitable to shut up four-months-old pigs in small pens to fatten them, especially when they are to be fed nothing but corn or Kafir corn. But if they must be fed under such conditions a little good cowpea hay in adition to the grain will help matters very much.

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NOTES ON TROUBLESOME INSECTS AND PLANT DISEASES.

Edwin Mead Wilcox.

MELON LOUSE.

The melon louse, *Aphis cucumeris*, did much damage during the last season, 1900, to the melons of the territory. (See Figure 1.) In fact this damage was so general and so extensive that many persons have decided to much reduce their acreage devoted to melon culture or even give up their cultivation entirely.

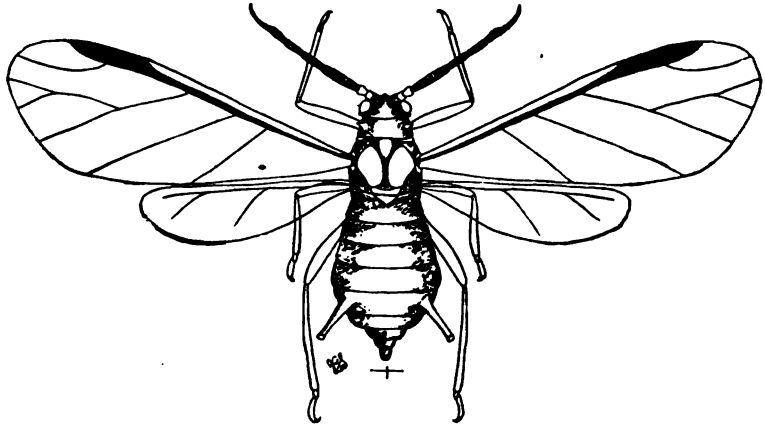

FIG. 1—*Aphis Cucumeris*, MELON LOUSE.
From Bulletin No. 72 of the New Jersey Experiment Station by Smith.

Very little is yet known regarding the life history of this very important plant louse. It probably winters over on the ground occupied by the melons and has been seen on the roots of the vines. If these are the facts in the case it is plain that the thorough clearing of the ground after the crop is harvested would tend to decrease their number very much during the following year. An experiment to test the efficacy of this method was commenced during the fall of 1900 but was interfered with by the transfer of the property to other hands.

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The lice present on the vines can be destroyed by thoroughly spraying with the usual kerosene emulsion. A cyclone nozzle must be employed for this purpose in order that the emulsion may be applied to the under sides of the leaves. A thorough spraying with kerosene emulsion in this fashion should destroy the lice at the first application.

HARLEQUIN CABBAGE BUG.

The Harlequin Cabbage Bug, *Murgantia histrionica*, made its appearance this spring in considerable numbers in Payne and Kingfisher counties on the rape and cabbages. This insect is often referred to as the "calico back" on account of the numerous yellow and red markings on the jet black that gives it its peculiar and striking appearance. (See Figure 2.) This insect was introduced from Mexico about 1860 and since then has spread over about all of the southern states. In 1870 it had made its way north to Missouri and in 1872 had reached Delaware and had done considerable damage in Colorado. It is now well established as far north as southern Ohio but it will probably not become a very serious pest north of that point.

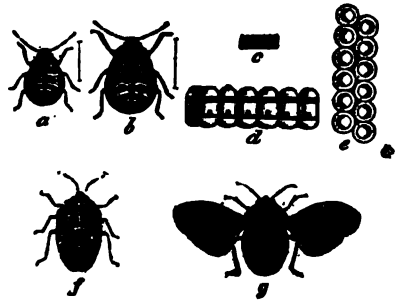

FIG. 2.—*Murgantia Histrionica*, HARLEQUIN CABBAGE BUG.
From Bulletin No. 68 of the Ohio Experiment Station by Webster.

It feeds upon cabbage, radishes, rape, cauliflower, turnips, and other members of the mustard family. The eggs are white with small black bands and are deposited in two parallel rows, of about five to seven each, on leaves and petioles of the plants mentioned. These eggs hatch in a few days and there are as many as five broods in this region. The last brood deposits the eggs from which are hatched the brood that are to winter over as partially mature adults.

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These bugs cannot be killed by spraying without injuring the plants upon which they are found. Resort must therefore be had to the followig methods. The refuse leaves and stems of the cabbage or other crop grown may be collected on the field to afford the bugs a harboring place to spend the winter—they can then be killed here by burning the pile of material late in the winter. Another good method is that of planting catch crops near the field in question. Wild mustard plants or some of the cultivated plants may be planted near the field to attract the insects when they appear in the spring and to afford them a place to deposit their eggs. These plants may then be sprayed with a very strong kerosene emulsion and all the bugs killed.

I have found in some cases associated with this bug one of the common lady bird beetles, *Hippodamia convergens.* Perhaps this beetle serves to keep the cabbage bug in check but this needs further investigation.

CHERRY TREE APHIS.

This well known plant louse, *Myzus cerasi,* seems to have been unusually prevalent throughout the territory this spring according to reports received at the station. In a few cases it appeared in such multitudes that the trees were practically defoliated in a very few days.

This louse is a deep brown or even black in color and infests the leaves, young twigs, blossoms and even the fruit of the cherry and plum. The sexed individuals do not occur until late in the season. The eggs are then deposited at the base of the buds and in the crevices in the bark where they remain over winter. The eggs hatch early in the season and the young are soon attached to the plant in large numbers sucking out its juices.

This louse may also be controlled by spraying with the kerosene emulsion or whale oil soap. The spraying should be done thoroughly as soon as the young appear on the trees in the spring so that no further damage will be done to the trees. The winged forms may come in then from other infected trees but they will be able to do but little damage to the fully mature leaves.

FALSE CHINCH BUG.

During the year the false chinch bug (See figure 3) has been reported from the following counties:—Kay, Kingfisher, Logan, Noble, and Payne. This so-called false chinch bug, *Nysius angustatus,*

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is frequently mistaken for the true chinch bug and it has been frequently sent into the station as the true chinch bug during the past year.

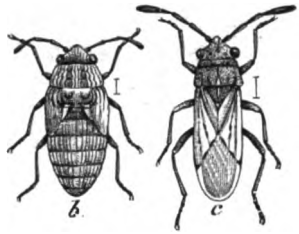

FIG. 3.—*Nysius Angustatus*, FALSE CHINCH-BUG.
From Report of Commissioner of Agriculture U. S. for 1887 by Riley.

The false chinch bug is a grayish brown bug resembling the true chinch bug somewhat in form and habits. It may easily be distinguished from the real chinch bug by the absence of the black spot at each side of the body and the fact that its wings are not so white as in the true chinch bug. Besides it is rather more active than the true chinch bug and flies up from the plants, on which it is feeding, like grasshoppers when one walks through the field.

They feed upon a great variety of plants but never attack any of the cereals. They have been known to feed upon the following plants: turnips, rape, flax, beets, cabbage, and potatoes. The following letter from a correspondent calls attention to their feeding upon the flax to a limited extent:

Glencoe, Okla., June 29, 1900.

Experiment Station, Stillwater, Okla.

Dear Sir:—With this mail I send you what is to me an unknown fly which has attacked the flax crop of our vicinity. They gather in myriads on the flax balls and seem not to eat in grasshopper fashion but to suck as chinch bugs do. They appear to attack flax most where there is a great deal of mustard growing in the crop. In fact they seem to eat the mustard pods first.

Yours very truly,

C. V. RYAN.

They seem to have a preference for the members of the mustard family and are frequently seen upon the common shepherd's purse and other native plants of this family. They usually feed in large

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groups on the plant and hence are able to soon destroy the plant. The leaves wither and curl up in a characteristic fashion but do not fall from the tree. The bug in other localities has been known to feed also upon the following plants: strawberries, grapes, young apple sprouts, etc.

Since this insect feeds upon native plants in the mustard family, all such should be removed from the farm for this simple precaution in itself is sufficient to greatly reduce their numbers and eventually to rid the fields of them entirely.

APPLE LEAF RUST.

During this year (1901) the apple leaf rust has appeared in many of the orchards of this Territory. This rust is produced by the same fungus that produces on the cedar the well known swellings called "cedar apples," *Gymnosporangium macropus.* In view of the great damage that will result to apple orchards as a result of the widespread introduction of this pest, it seems well at this time to call special attention to its life history and the means of combating it successfully.

The fungus produces on the cedar the peculiar swellings referred to as "cedar apples;" these swellings are of sizes varying from the size of a pea to that of a large horse-chestnut and are reddish in color. In the late spring or early summer the fungus that produced these swellings protrudes from the "apple" in the form of numerous orange yellow gelationous masses, the color being due to the numerous spores that are produced on the surface of these swellings.

These spores germinate while yet enclosed within the gelatinous masses and produce each several secondary spores, or conidia. These conidia falling into the air are carried to some apple tree and there adhering to the tender leaves germinate and send a tender tube into the tissues of the leaf. Within the leaf this tube branches repeatedly to form a net work of tubes, the mycelium of the fungus, that secure the nutriment for the fungus.

On the upper sides of the apple leaves there appears as a result of this infection numerous rust colored spots. These spots increase in size considerably and by the middle of the growing season there may be noticed within these larger spots certain blackish cavities within which there are produced spores of uncertain function. Somewhat later there appear on the lower sides of the leaves

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tooth shaped projections opposite these spots just mentioned. These tooth shaped projections contain numerous yellow spores that will germinate only when transferred to the cedar tree, and there they produce a mycelium within the twigs and eventually produce the swellings already mentioned above. Thus it is seen that this fungus in its complete life cycle produces three entirely different sorts of spores on two quite different plants.

From what has been said the remedial and preventive agents are easily deduced. All these cedar apples should be promptly removed and burned for they are fertile sources of infection of the apple trees in the whole neighborhood. And it must be remembered that the conidia produced on these apples are carried in many cases as far as eight miles and are then able to infect any apple tree with which they may come in contact.

Besides this all infected apple leaves should be gathered up at intervals as they fall from the tree and burned; of course if there are but a few diseased leaves on the tree they are easily gathered and burned and the disease may thus be easily checked. From the nature of the case this disease must be given careful attention by all apple growers to avoid the disaster sure to result from allowing it to once gain a foothold in the orchards of the territory.

RUSTS OF CEREALS.

The recent advances made in the study of the rusts of cereals have been marvelous and have entirely changed the procedure to be followed in combating these great enemies of wheat culture in all parts of the world. In fact the damage due to these rusts is in some parts of the United States greater than that due to all other enemies of wheat put together.

We have in the United States at least six and perhaps seven sorts of rusts on cereals as follows: orange leaf rust of wheat, orange leaf rust of rye, crown rust of oats, black stem rust of wheat and barley, black stem rust of rye, black stem rust of oats, and maize rust. Of these the black stem rusts of oats and wheat are the most destructive as a rule in our region.

The life history of the rusts has been much complicated by the recent discovery that in certain cases the germ of the rust plant is located inside of the cells of the seed and hence is entirely removed from any means of treatment. If it is found that all the species of rusts or at least the common ones with us are thus able

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to exist in such intimate connection with the seed of the plant upon which they are parasitic, then we must confine our attention to the securing of resistant or rust proof varieties. In fact much has been done along this direction and the work is being rapidly carried on by the Department of Agriculture.

The fact that certain stages of the orange leaf rusts of both rye and wheat are able to winter over on the leaves of these plants shows the great advantage of destroying all volunteer wheat and rye that may appear on the farm. It is not yet known that the black stem rust of either wheat or oats is able to winter over in our region.

And since treatment of the seed as mentioned for the smuts does not avail anything we must look to rust proof varieties even if we do find that none of our varieties ever contain within their seeds germs of the rust parasitic upon them. And these new varieties will be secured through the crossing of varieties having desirable qualities and that are known to be rust proof under the conditions prevailing in any given locality.

SMUTS OF THE CEREALS.

The great amount of damage caused by these parasitic fungi commonly called smuts, has everywhere attracted attention since the time of the Greeks and the Romans. The black powdery mass of smut is composed of the reproductive bodies, the spores. These spores when they are placed under the proper conditions are able to germinate and send out a slender tube on which are found certain smaller secondary spores, the conidia. The tubes or mycelium formed by the germination of these secondary spores are able to enter the tissues of a living plant and from it take the food materials that it needs. The mycelium is therefore the vegetative portion of the smut plant while the spores are the reproductive organs of the plant.

Cereals in America are attacked by several species of the smuts but all may be divided into the two following general classes: (a) the stinking smuts destroy the kernel only and the mass of spores formed inside the kernel has a very disagreeable odor, while (b) the loose smuts attack the chaff as well as the kernel and do not have the odor characteristic of the former class of smuts. Besides, the loose smuts are more powdery and loose than the former class.

Wheat is attacked by two stinking and one loose smuts in

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America. One description will here suffice for the two species of the stinking smuts for they may be distinguished only by the use of the miscroscope. In these two stinking smuts the smutted grains produced are somewhat larger than are those of the healthy plants and are apt to be somewhat wrinkled. When the diseased kernels are broken open they disclose a mass of spores that emit a very pungent and disagreeable odor that gives this class of smuts its name.

That is, the mycelium of the fungus has grown with the plant and having entered the developing kernel forms there the mass of spores which replaces the normal seed formed on the healthy plant.

These stinking smuts of wheat annually cause considerable damage to wheat in all parts of the wheat growing belt but it is very difficult to give even an approximate estimate of the amount of this loss. It is well to remember that when it is once introduced it increases rapidly from year to year if it is not checked and the percentage of smutted plants may reach as high as 50 per cent or even 75 per cent. Directions for treating the seed to be planted in order to get rid of this great pest will be given later on in this discussion.

The loose smut of wheat attacks the chaff as well as the kernel and has no foetid odor. The smut ripens with the flowering of the perfectly healthy plant and at harvest time there is left only the bare stalk, the kernels having been blown away by the wind.

This loose smut, though it causes considerable damage to wheat in many localities, does not lend itself to preventive treatment so well as the two stinking smuts and therefore is more to be feared when it is allowed to once become well established. The best plan is to secure the seed wheat from fields that are known to be free of the loose smut. If this plan is regularly followed no great fear need be entertained of the loose smut of wheat.

Oats are attacked by none of the stinking smuts as in the case of wheat. The loose smut of oats, like that of wheat, ripens with the flowering of the healthy plants and is blown about the fields with the wind. (See Figure 4.) This smut is widely distributed and few fields are entirely free from it while many are annually destroyed by it. In some cases the amount of smut reaches 15 per cent and in this case the damage is of course very great. Dr. Kellerman determined that the loss in Kansas in 1890 due to this smut alone was nearly one million dollars while Swingle

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FIG. 4.—SMUT OF OATS.

From Bulletin No. 8 of the Kansas Experiment Station by Kellerman and Swingle.

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determined that the annual loss in the United States due to the same cause is about eighteen million of dollars; surely such great losses as these should be prevented.

But even these high figures do not properly represent the total loss from untreated fields compared to treated fields since it has been shown that the treated seed gives a larger yield than would result from the substitution of healthy plants for the smutted plants in the field. That is, the treatment of the seed as hereafter described gives not only a crop free from smut but also actually increases the yield over that of untreated seeds free from smut. Swingle has well pointed out that it costs as much to grow a smutted crop as to grow a healthy crop and that the smutted plants take up as much room on the ground and extract from it as much food material as do healthy plants. Besides the constant planting of seed taken from smutted fields will be sure to result in greater and greater losses year after year as this very careless practice is followed.

Barley is also attacked by two species of loose smuts similar to loose smut of oats. This may also be prevented by the treatment outlined below.

As a basis for the correct understanding of the treatment-method to be described it is well to bear in mind certain important facts regarding the life history of these smuts we have been considering. It is now well known that the infection in the case of the smuts of cereals we have mentioned takes place only during a very few days after the germination of the seed in the soil. That is, the germ tube is only able to gain an entrance to the plant through the very tender and rapidly growing cotyledon or first seed leaf of the plant, before the plant has formed any green leaves at all. It is certain that the smut spores adhering to the seed when planted germinate when the seed germinates and the infection occurs at once if at all.

It is therefore plain that the only practicable treatment-method must aim to destroy the spores adhering to the seeds that are to be planted. The "bluestone" method was one of the earliest methods suggested but should be avoided as there is great danger of using so strong a solution of the "bluestone" or copper sulfate that the germinating power of the seeds treated will be either greatly reduced or perhaps entirely destroyed. Much the same thing may be said of the use of other chemicals in the treatment of seed on a large scale.

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The "Jensen-hot-water" method was recommended in 1888 by Professor Jensen, a Danish student of this subject and this method is the one to be preferred for the treatment of large quantities of seed for smut. The following account of this method is taken from a recent excellent summary of this subject by Swingle in the yearbook of the Department of Agriculture.

"THE HOT-WATER TREATMENT FOR STINKING SMUT OF WHEAT AND OAT SMUT.

Provide two large vessels, preferably holding at least 20 gallons. Two wash kettles, soap kettles, wash boilers, tubs, or even barrels, will do. One of the vessels should contain warm water, say at 110 to 120 degrees F., and the other scalding water, at 132 degrees to 133 degrees F. The first is for the purpose of warming the seed preparatory to dipping it into the second. Unless this precaution is taken it will be difficult to keep the water in the second vessel at the proper temperature. A pail of cold water should be at hand, and it is also necessary to have a kettle filled with boiling water from which to add from time to time to keep the temperature right. Where kettles are used a very small fire should be kept under the kettle of scalding water. The seed which is to be treated must be placed, half a bushel or more at a time, in a closed vessel that will allow free entrance and exit of water on all sides. For this purpose there can be used a bushel basket made of heavy wire, inside of which is spread wire netting, say 12 meshes to the inch; or an iron frame can be made at a trifling cost, over which the wire netting can be stretched. This will allow the water to pass freely and yet prevent the passage of the seed. A sack made of loosely woven material, as gunny sack, can be used instead of the wire basket. A perforated tin vessel is in some respects preferable to any of the above. In treating stinking smut of wheat, the grain should first be thrown into a vessel filled with cold water; then, after stirring well, skim off the smutted grains that float on top and put the grain into the basket or other vessel for treatment with hot water. This skimming is entirely unnecessary with other grains, and even with wheat when affected only by the loose smut. Now dip the basket of seed in the first vessel, containing water at 110 degrees to 120 degrees F.; after a moment lift it, and when the water has for the most part escaped plunge it into the water again, repeating the operation several times. The object of the lifting and

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plunging, to which should be added also a rotary motion, is to bring every grain in contact with the hot water. Less than a minute is required for this preparatory treatment, after which plunge the basket of seed into the second vessel, containing water at 132 degrees to 133 degrees F. If the thermometer indicates that the temperature of the water is falling, put in hot water from the kettle of boiling water until the right degree is attained. If the temperature should rise higher than 133 degrees, add a little cold water. In all cases the water should be well stirred whenever any of a different temperature is added. The basket of seed should very shortly after its immersion be lifted and drained, and then plunged and agitated in the manner described above. This operation should be repeated six or eight times during the immersion, which should be continued ten minutes. In this way every portion of the seed will be subjected to the action of the scalding water. In practice it will be found best to have a man or boy devote his whole time to keeping the temperature at the right point, adding a little hot water if it falls below 132 degrees and a little cold if it gets above 133 degrees F. Another man should handle the grain and immerse and drain the portion being treated as directed above. After removing the grain from the scalding water, spread on a clean floor or piece of canvas to dry. The layer of grain should not be over 3 inches thick. If it can not be spread out at once, dip in cold water and set to one side until it can be attended to. It dries better if spread while still hot. Another portion of grain can then be treated, and so on until all the seed has been disinfected. Directions for drying the seed will be given further on.

The important precautions to be taken are as follows: (1) Maintain the proper temperature of the water (132 degrees or 133 degrees F), in no case allowing it to rise higher than 135 degrees or fall below 130 degrees; (2) see that the volume of scalding water is much greater (at least six or eight times) than that of the seed treated at any one time; (3) never fill the basket or sack containing the seed entirely full, but always leave room for the grain to move about freely; (4) leave the seed in the second vessel of water ten minutes.

HOT-WATER TREATMENT FOR LOOSE SMUT OF WHEAT AND FOR BARLEY SMUTS.

In treating wheat for loose smut, the grain must be soaked four hours in cold water, then set away about four hours more in

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wet sacks, and finally treated as directed above, but only for five minutes, at 132 degrees F. In planting, use one-half more seed per acre to compensate for the seed killed by the treatment. For preventing both of the smuts affecting barley the grain should be soaked as directed above and treated five minutes at 130 degrees F., 2 degrees lower than for wheat.

DRYING THE TREATED SEED.

All of the seed treatments leave the seed wet and necessitate drying before planting. The grain should be spread in a layer 2 or 3 inches deep and should be shoveled over twice or three times a day. It will then dry very quickly. A clean floor is a good place to dry the grain, but a better method is to take canvas sheets about 5 feet by 12 or 15 feet and spread out in the sun. Such sheets, with the grain, can be taken in at night. If spread over an open lattice work a few feet from the ground, drying is greatly facilitated. Such sheets of the heaviest ducking, should not cost over $1.75 each, and can be used for years. The grain can be sown broadcast long before it is thoroughly dry, but for drilling it must be nearly dry. The seed can be treated months before being used, and dried and stored ready for planting. In case of the stinking smut of wheat there is danger of the seed being reinfected by contact with living spores, though with other smuts the danger is almost absent. In treating wheat against this smut, tools and sacks should be disinfected, and if a floor is used for drying, it should first be washed with a solution of bluestone (1 pound to 10 gallons of water) before spreading the grain. Canvas sheets and sacks can be disinfected easily by plunging into boiling water."

CORN SMUT.

This disease occurs to some extent wherever Indian corn is grown but never has caused a large amount of loss by its attacks. It is probably known to every farmer of this territory. This disease is caused by a parasitic fungus, *Ustilago zeae*, closely related to the fungus causing the loose smut of wheat and oats. (See figure 5.)

This corn smut usually makes its first appearance on the leaves of the plant when it is at least two months old. Here will be seen small whitish, wrinkled elevated spots which later turn jet black due to the formation within them of the spores of the fungus. Later

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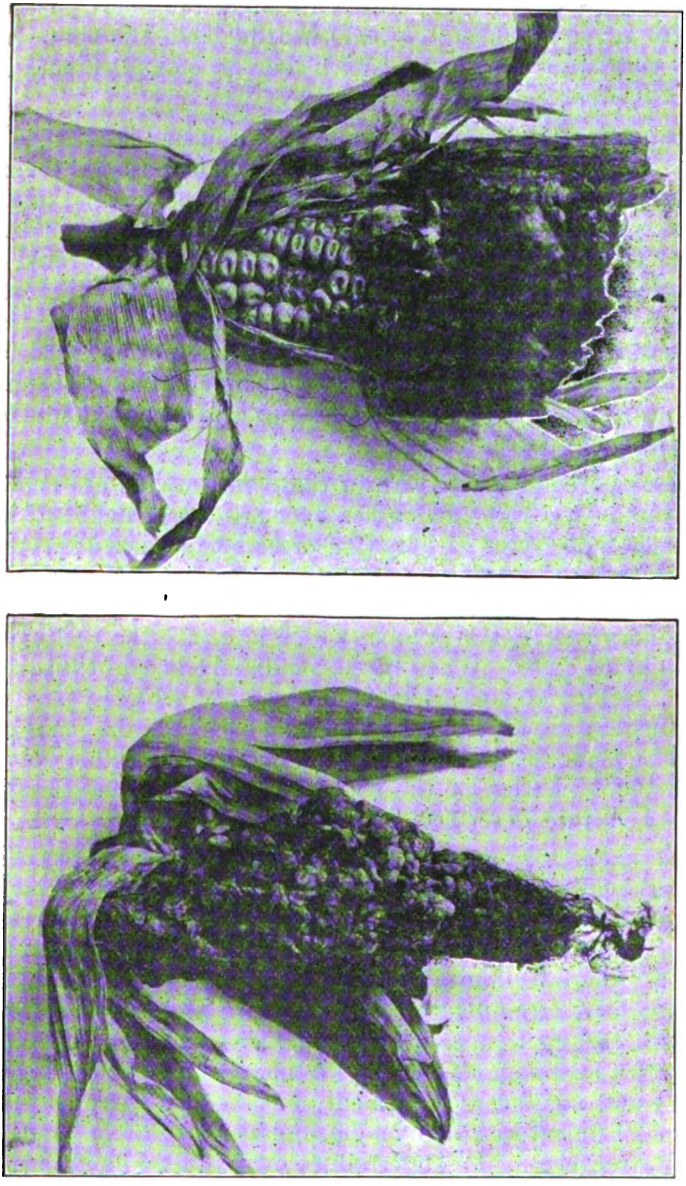

FIG. 5.—CORN SMUT.
From 12th Annual Report of the Indiana Experiment Station by Arthur and Stuart.

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on as the plant has formed a definite stem the smut pustules appear also at the bases of the leaf sheaths; here the spots are frequently very large outgrowths which soon become filled with a mass of black spores.

Frequently these same smut spots appear scattered about through the tassels but it is perhaps more common to find them forming an immense development at the base of the tassels; and when it occurs at this last point the tassels are forced to one side. But the most conspicuous smut spots are those that are formed in the ear of the corn. The entire ear may be converted into a great mass of these outgrowths filled with the smut spores or else only certain portions of the ear may be so altered and some normal seed be produced. And in the late summer it also happens that the secondary ears situated lower down on the stem are also attacked and become large masses of spores.

These spores produced within these outgrowths are easily carried about by the wind and other agencies—it is doubtful if they retain their capacity of germinating after being passed through the digestive tract of an animal. Under proper conditions these spores germinate and produce on the ends of small branches several smaller secondary spores, the conidia, which later are the real agents of infection in all cases. When these conidia are brought into contact with the surface of some tender and rapidly growing part of the corn plant they are able to germinate and send into the plant a tube. Within the plant the normal mycelium is formed and this eventually leads to the formation of the characteristic smut masses and outgrowths as before described.

Until about 1895 it was supposed that the infection occurred in the young seedling through the germination of spores that had been planted with the seeds or were in the ground where the seeds were placed. But the classical researches of Brefeld and others have shown that the infection takes place later on in the life of the corn plant. In fact, attempts to infect the corn plant by p'anting the seeds with the smut spores on them have proven failures. And based on this mistaken idea of the life history of the corn smut fungus, the usual method of treatment consisted of treating the seed with some chemical to kill the adhering spores. But of course this method proved here a complete failure owing to the facts just mentioned.

Brefeld brought to light the true life history and showed, as

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has been said, that infection could take place at any point on the plant where the tissues were tender and growing. He further showed that the aerial conidia were the fertile sources of infection and not the black spores produced within the outgrowths described above. These black spores germinate readily especially when brought in contact with moist and rich soil or particularly with rich fresh manure.

The first infection of the plant in the spring is probably due to the conidia produced upon the tubes resulting from the germination of the black spores produced the preceding year that have wintered over in the soil or in the immediate neighborhood. But later on in the season it is quite likely that other infections may occur through the conidia produced on the black spores formed the same year.

This knowledge forms the basis for the rational treatment of the disease under consideration. Spraying with the usual Bordeaux and other mixtures has not proven eminently successful as yet and little hope can be expressed that it ever will in this case. The only means of combating the disease where it is so abundant as to make that desirable is to remove and burn all the smut outgrowths as soon as they appear.

By carefully following the suggestions here made, the amount of smutted plants can be kept below 2 per cent and it is doubtful if it will pay to much reduce this amount at least with the means now available.

SORGHUM SMUT.

Sorghum is affected with two sorts of smut: the "grain" smut attacks the individual grains only, while the "head" smut attacks the entire head or panicle of the sorghum and soon converts it into a mass of blackish-brown spores covered at first by a white membrane. These two smuts are fortunately not very abundant in this region and hence no great fear need be entertained of their doing any very great damage in the near future. No practicable method of preventing these smuts has as yet been suggested.

Persons interested in the subject of smuts and rusts of our cereals can secure much valuable information in the following publications of the stations and the U. S. Department of Agriculture: Illinois 57; Indiana 26, 28, 32, 35, 41, and 45; Iowa 16, 18, 20, and 24;

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Kansas 8, 12, 15, 21, 22, 23, 42, 46, 62, and 74; Nebraska 11; North Dakota 1, 19, and 27; Ohio 44, 57, 64, and 97; Yearbook of the U. S. Department of Agriculture for 1894; Division of Vegetable Physiology and Pathology of the U. S. Department of Agriculture 16.

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THE ORCHARD.

O. M. Morris.

LOCATION.

The orchard and fruit plantation should be located on sloping land. The soil will be drained of surplus water and will not bake and become as dry and hard in time of drouth. The north and east slopes are the best. They are much cooler in summer and are not subject to as great variations of temperature in winter. The effect of the afternoon sun is somewhat weakened by the slope and the early blooming trees are not forced into bloom so early and more frequently escape the late frosts.

The protection from the wind is perhaps the greatest benefit derived from such slopes. The warm dry winds of July and August do not strike the orchard with their full force and thus a great amount of moisture is saved for the use of the trees and fruit. This protection from the wind is also of great value to young trees while they are forming their root system and becoming well established.

The southern slopes are warmer and earlier in the spring and for some purposes are to be preferred, but usually the fruit matures early enough and with apples in particular the latest varieties mature almost too early for winter use.

A sandy loam soil with clay subsoil is best adapted to the use of all kinds of fruits. The trees set on heavy clay soil will produce a heavy growth of foliage and wood but will be slow to come into bearing, and the fruit will not be as bright in color as that grown on sandy soil. The trees grown on a poor sandy soil will usually make a poor growth and begin bearing young. These trees will be short-lived and weak. The poor, thin, gray and black soils are poorly adapted to trees. The trees set on such land are almost sure to make a very poor growth and be shy bearers. Good upland is the best for orchard land. The bottom land will grow better and stronger trees but they will seldom be as productive. This is especially true of the peach, plum and apricot. The late frosts are

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more liable to destroy the crop while the trees are in blossom on low land. The lowland also maintains better conditions for the plant diseases that are sure to infest the orchards sooner or later. If the land was formerly in timber, it should be carefully examined for evidences of root-rot before setting out fruit trees.

PREPARATION OF THE LAND.

The land should be cultivated for two or three years and freed of all wild sod and weeds before it is set to orchard. The land should be plowed deep so as to give as deep soil as possible. Most of the prairie soil in Oklahoma is very poor in humus or decaying vegetable matter. Such lands should be well manured before the orchard is set. The manure should be scattered evenly over the field and turned under with the turning plow. The practice of applying large quantites of manure in places where the tree is to stand can not be recommended. This practice of uneven manuring is usually carried out in one of two ways. The manure is applied very thickly in the immediate vicinity of the tree and worked into the soil or it is thrown in dead furrows that are made in the row where the trees are to be set, and then covered. The manure will decay faster if evenly distributed over the land. The trees will gather food from all directions and form a better root system. Where the fertilizer is unevenly distributed, the roots seek the most fertile soil and are developed there in greatest numbers. As a result the water is taken out of such places very fast and in dry weather these spots dry out and the greater part of the root system is left without water. Trees set on such land will always suffer more for water than on soil evenly fertilized.

Subsoiling is beneficial on soil that has a hard clay subsoil. Throwing out a deep dead furrow where the row of trees is to stand and then filling again after the trees are set is often of value both to loosen the subsoil and to help drain the land. These furrows should run up and down hill and be as deep as is possible to make them with the tools at hand. The water that stands on the ground seldom does any harm to the trees but the soil becomes packed and in a little dry spell bakes and dries out very rapidly. A short time before the trees are set the land should be stirred deep and the soil well pulverized and left in a smooth, level condition free from dead furrows and ridges.

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CULTIVATION.

The cultivation of the orchard should begin as soon as the trees are set and continue throughout the life of the orchard. The first work should be done with the turning plow early in the spring before the trees start to grow. The soil should be stirred deep and well pulverized. All manure and trash that is on the surface should be turned under and covered well so that it will decay rapidly. The plow should run as close to the trees as possible without barking the trees or limbs with the harness. A little pruning of the shallow roots will not harm the tree and will often be a benefit to it by helping to form a deep root system. It is best to use a small plow, not larger than 12 inches, for this work. The furrows and ridges left will be smaller and can be reduced and leveled over with less trouble. The land should be harrowed and smoothed down as soon as plowed. This deep plowing and working the soil serves several important purposes.

Plowing and stirring the soil fines it and increases the depth thus giving a greater feeding surface, foraging, and root-hold area to the plants. The soil requires thorough pulverizing and mixing that it may give the best conditions for root growth. There is but very little vegetable matter in the average soil in Oklahoma and the soil when plowed simply breaks into small clods that are hard and compact and almost impenetrable to root growth. These clods yield very little food to the plants, although they usually contain an abundance. When these clods are broken up and pulverized so that the air and moisture in the soil can act upon them the plant food is made available to the plants and used by them.

One of the most important benefits derived from deep plowing is the increasing of the water-holding capacity of the soil. The water that is held in the soil consists of a thin film of water surrounding each particle of soil. The finer the soil the more water it will hold. The deep plowing will furnish a deep bed for the water. The annual rainfall is great enough to supply the wants of all our orchard fruits but it is so distributed that during the spring and fall there is an over-supply of water and during the summer there is not enough to supply the demands of the trees. All the methods of tillage that will help to retain the moisture in the soil should be used if possible.

The spring and summer cultivation should keep the surface level and well pulverized. No weeds or grass should be allowed to

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grow in the orchard. The weeds and grass are sometimes let grow in the vain hope of shading the ground and thus saving the moisture. The result of such a method is that the moisture is taken out of the soil by the weeds much faster than it would be by the sun. Shallow level culivation forms an earth mulch and is the best method of conserving the soil moisture. The orchard should be cultivated after each rain to break the crust and prevent the soil from baking. This cultivation should begin early in the spring and continue until late in the summer.

The deep plowing in early spring and shallow cultivation during the summer are of great value in reducing the soil temperature during the hottest part of the summer. The deep bed of soil and shallow mulch act as a dead air space and prevent the heat penetrating deep into the soil. This benefit of cultivation is most apparent on large trees that are in bearing. The foliage retains a deep green color until fall and the fruit is full size and well matured. The trees can not grow and mature fruit when the roots are in dry, hot soil.

The method of cultivation described in the foregoing paragraph should be put into operation as soon as the orchard is set and followed from year to year. After the trees become large and cover most of the ground the deep plowing may be dispensed with, and the soil worked up in the spring with some form of disk or spading harrow. The shallow surface cultivation must be continued as long as profitable returns are expected from the orchard. The practice of seeding down the old orchard cannot be expected to give good results in Oklahoma, unless the orchard happens to be in some very much favored location. The long summers with light rainfall will probably always be the main obstacle in the way of such treatment.

TOOLS USED IN ORCHARD CULTIVATION.

The ordinary two horse plow is the best implement to use in early spring. This will stir the soil to a good depth and put it in such condition that the rain will sink down and not run off the land. It also leaves the surface open and free from trash and litter that would be in the way of the cultivator. The plow can be run as close to the tree as the team can be driven without danger of barking the tree or limbs with the harness. If the plow passes too close to the tree it should be turned out of the ground or raised so

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as to run very shallow. A small plow six or eight inches wide is very good to finish around the trees and along the dead furrows but it is not necessary. Some form of a plow is necessary and the orchard can not be well cared for without it.

The shallow summer cultivation can be done with several different kinds of tools. The small shovel cultivator is a very good tool and can be used for a great many purposes. The one horse five shovel cultivator is one of the best tools for a small place. It can be adjusted to do almost any kind of work, and to work in narrow spaces. It destroys the weeds, breaks up the surface soil and leaves it level. There are several kinds of disk harrows and cut-away harrows that do good work and leave the soil in an almost ideal condition. The disk harrow is one of the best tools for summer cultivation of the orchard. It destroys the weeds and leaves the soil level and well pulverized, thus forming a good mulch. The cutaway harrows are good for surface cultivation but do not as a rule work well if there is much trash or weeds and grass on the ground. The common straight and slant-toothed harrow is of great value in smoothing down the surface of the soil after the plow and heavy cultivators. It is also of value to break the crust of the soil after a rain. There are several kinds of spring toothed harrows that do good work and are valuable as surface cultivators. The roller and drag are of but little value in orchard cultivation. The roller can be used to advantage sometimes on very loose, gravelly soils.

CROPPING THE ORCHARD.

The orchard should be given clean cultivation from the start. The trees should not be compelled to share the fertility and moisture of the land with other crops. If this method is followed from the start it will be much easier to keep the land free from weeds and to give the trees better care. The will reduce the labor of caring for the orchard to the minimum. Some kinds of crops can be grown in young orchards without doing much harm to the trees. The hoed or cultivated crops are all that should be planted between the trees and then the trees should have plenty of room. Early potatoes and such early maturing crops are best to be used for such purposes.

The cultivation should be primarily for the orchard and not for the crop. The moisture should be saved for the trees as much

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as possible. The sowed crops, such as wheat and oats should never be grown in the orchard on account of preventing cultivation at the time it is most needed. The growing of all kinds of harvest crops should be discontinued under all conditions and circumstances after the orchard is four or five years old. The trees draw moisture from a much larger circle of ground than that covered by the top and by the time the orchard is five years old all of the soil space will be drawn on for moisture.

COVER CROPS.

Cover crops are crops grown on the land during the late summer, fall, and winter and left on the ground for the purpose of covering the soil during winter and thus preventing its blowing, to catch and hold the rain and snow, to form a mulch, and to add vegetable matter to the soil. In young orchards the cover crops are often of great value but in the older orchards their value is often questionable.

The value of a cover crop depends much upon the kind of crop and the time it is sown. Cowpeas and plants of that class are valuable fertilizing plants and form a good cover for the winter. The greatest objection to this crop is that it must be sown early in the summer so that it can make its growth before frost in the fall. This places the crop on the land during the most of the dry weatner when all of the moisture is needed by the trees. The bad effect of this will be noticed most on bearing trees by the fruit falling before maturing. Wheat and rye can be sown much later and will make a good cover for the winter and furnish a good supply of manure to be turned under in the spring. These crops would remove soil moisture during the fall and winter and would not be harmful to the trees. The peach tree might suffer loss of fruit buds if the ground becomes too dry during cold weather, but most of the orchard fruits usually pass the winter without suffering much for water.

The cover crop will, if properly handled, improve the physical condition of the soil and increase its water-holding capacity but there may be a doubt as to whether it will do this to sufficient extent to furnish the extra amount of water used by the growing crop. On June 20, 1899 a plat in the station apple orchard was sown to cowpeas. The peas grew and made a good mulch which laid on the ground all winter and was turned under in March,

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1900. July 16, 1900, the same plat was sown to cowpeas as before. They made a better mulch than the previous crop and were treated in the same way. During the summer of 1899 the trees that were surrounded with cowpeas showed by comparing with trees of an adjoining plat that was given clean cultivation, that the cowpeas were robbing them of moisture. During the summer of 1900, however, no difference could be seen in the condition of the trees in the two plats. In January, 1901, the measurements of all the trees were taken and compared with measurements taken in January, 1899. There was no appreciable difference in the growth made by the two plats of trees. These plats have not been under treatment long enough to furnish definite results, but it seems to indicate that this method of growing cover crops may be beneficial on poor land.

MANURING THE ORCHARD.

The soil in most parts of Oklahoma contains a sufficient supply or plant food to produce large thrifty trees and good crops of fruit. The addition of decaying vegetable matter to the soil is the best thing that can be done in most cases. This material should be applied in the form of manure and green crops as much as possible. The plant-food contained in the manure and green crops is valuable when placed in the soil but the improvement in the condition of the soil is often of even greater importance. The soil becomes more mellow and porous and is capable of holding much more water. The air can pass through the soil much better and carry on the work of decay much faster. The application of commercial fertilizer is not neccessary in most cases and would not pay for the material used. Concentrated fertilizers should be used only on land that is in good physical condition and well cultivated. It may be used on other land but it cannot yield its best returns on such land. Barnyard manure is the best fertilizer for most farms and for most crops. The use of lime and wood ashes is to be commended if the land contains a large amount of humus and is free from alkali. Alkali lands can be improved by thorough drainage and the application of large quantities of manure.

CHOICE OF VARIETIES.

The subject of choice of varieties is the one upon which most questions are asked and the one upon which the least satisfac-

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tory advice can be given. The choice of varieties brings in so many personal likes and dislikes that in the end the orchardist must and does choose his own varieties. The orchardist should first study his soil, his location and surroundings. This will enable him to tell what class of trees and fruit will be best suited to his location. With this information in hand he is able to select the varieties that suit him.

Do not covet a variety simply because it was a favorite in an old orchard in another state, but take those that are doing well in your own locality. It is probable that many of the trees claimed to be untrue to name are what they were sold for. The orchardist formerly knew them with different condition of climate and expects them to be here just like those he used to know. There has been an enormous amount of poor trees that were untrue to name sold in the territory and many are still being sold. The reliable nurseries are fast driving out these irresponsible tree dealers and should have the entire support of all fruit tree buyers.

Th following varieties of fruit have been planted by fruit growers in different parts of the territory and in most cases are giving satisfaction. The varieties are arranged in order of their preference by the fruit growers.

APPLES.

1. Missouri Pippin,
2. Ben Davis,
3. Winesap,
4. Jonathan,
5. Arkansas Black,
6. Maiden's Blush,
7. Mammoth Black Twig,
8. Cooper's Early White,
9. Yellow Transparent,
10. Gano,
11. Red Astrachan,
12. Lowell,
13. Rome Beauty,
14. Janet,
15. Oldenberg,
16. Early Harvest,
17. Grime's Golden Pippin,
18. Sweet June,
19. Red June,
20. Wolf River,
21. Striped Red June,
22. York Imperial,
23. Summer Queen,
24. Romanite,
25. Sops of Wine,
26. Shockley,
27. Benoni,
28. Shannon Pippin,
29. Buckingham,

PEARS.

1. Kieffer,
2. Bartlett,
3. Duchess,
4. LeConte,
5. Garber,
6. Seckel,
7. Sheldon,

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PEACHES.

1. Elberta,
2. Alexander,
3. Champion,
4. Crawford's Late,
5. Crawford's Early,
6. Heath Cling,
7. Salway,
8. Amsden.
9. Chinese Cling,
10. Gen. Lee,
11. Mamie Ross,
12. Sneed,
13. Arkansas Traveler,
14. Early Rivers,
15. Triumph,
16. Hale,
17. Oldmixon Cling,
18. Oldmixon Free,
19. Indian,
20. Picquet Late,
21. Bell's October,
22. Crosby,
23. Stump,
24. Globe,
25. Wonderful,
26. Snow,
27. Family Favorite,
28. Foster,
29. Carman,

PLUMS.

1. Wild Goose,
2. Abundance,
3. Burbank,
4. Wickson,
5. Marianna,
6. Damson,
7. Botan,
8. Golden Beauty,
9. Arkansas Lombard,
10. German Prune,
11. Weaver,
12. Green Gage,
13. Quaker,
14. Wilmeth,
15. Satsuma,
16. Shipper's Pride,
17. Miner,
18. Normand,
19. Ohio Prolific.

CHERRIES.

1. Early Richmond,
2. English Morello,
3. Montmorency,
4. Mayduke,
5. Dyehouse,
6. Gov. Wood,
7. Ostheim,
8. Olivet,

APRICOTS.

Observations made in different parts of the territory seem to indicate that a full crop will be very rarely obtained. The trees make a good growth and set an abundance of fruit-buds which are usually killed in the winter or by late freezes in the spring. The blossoming period may be delayed from two to four days by keeping the branches of the trees well coated with whitewash from December until the flowers open. This method will not, however, be found very efficient. Last spring, two weeks after the flowers were open, there was enough frost to kill most of the crop under ordinary conditions. Laying down as with blackberries has been tried but it is only partially successful. The orchardist must depend on selecting such varieties as will best survive the frosts and plant them in such positions that they will be protected from the heat of the sun. The Jackson and Golden Russian seem to stand

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the late frosts better than other varieties in the station orchard. Although neither of these have borne half of a crop, they have ripened a few fruits each year for the last six years. The following are the varieties which were planted by the station:

1. Alexander
2. Budd
3. Early Golden
4. Gibb
5. Golden Russian
6. Jackson
7. Luizet
8. New Castle
9. Oldberg
10. Peach
11. Shemsi

BUYING THE TREES.

It is the best plan to buy the trees in the fall of some nearby nursery that the buyer can visit and buy the trees on the ground. This will save the expense of freight and enable the buyer to get the trees home in first class condition. Trees transported long distances will usually live and do quite as well as locally grown trees if they are properly packed for shipment and are delivered in good condition. If trees of the desired variety cannot be obtained of reliable nurserymen it is often a good plan to buy good thrifty stock of some other variety and then the following year bud or graft the top ones of the desired variety.

The buyer should not always take the cheapest trees. A good tree is worth more than a poor one and the difference in their value will grow greater as the trees grow older. Good trees are the best and cheapest for all purposes and should always be used if they can be secured. Exhorbitant prices do not insure good trees and should not be paid. The variety of fruit that is claimed to be entirely new and the equal of which has never been known, is out of place on the average farm. A strange characteristic of such varieties is that they always originate in some other part of the country and there is no orchard near in which this variety is in bearing to prove its merits.

The buyer should take only trees that are thrifty, well grown, and free from blemishes and indications of insects and diseases. The tree should present the characteristics of the variety to which it belongs. They should be well branched, wood firm, and buds well developed. The budded and grafted trees each have their strong points and nature of the variety, the location, and the desires of the grower must decide which to take. The peach, plum, cherry, and apricot are almost always budded. The apple and pear are usually

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grafted, although budding on these is quite common in the east and is being used more each year in the west. Practically there is but little difference between the whole-root grafted tree and a budded tree.

The whole-root and piece-root grafts each have some advantages over the other, and the climate, and variety of the tree should determine which should be used. The whole-root graft requires one seedling for each graft. The piece-root one seedling for every two or three grafts. These are facts that interest the nurseryman more than the fruit grower. The whole-root trees will grow much faster for the first three or four years and will form a better and more evenly distributed root system than the piece-root graft. It will be better braced and will stand much better when exposed to hard winds than the piece-root grafts. The whole-root graft has a root system already developed for it to begin growth upon. The piece-root graft is reduced almost to a cutting and must grow as such. If the cion of the piece-root graft is made long and set deep in the ground it will often strike roots and soon be up on its own root. This is a great advantage in very cold climates or where the roots winter kill badly.

SETTING THE TREES.

Fruit trees should be set in November or December in this latitude, and may be set in March. They are frequently set too close together for them to attain their full size and productiveness. Trees are wide feeders and should be set far enough apart to develop their natural form and size without being crowded by neighboring trees. There should be space enough between the trees after they are full-grown to admit of the regular operation of cultivation and spraying. These operations must continue as long as the orchard lasts and room must be left for the work to be well done. The distance at which trees should be set will depend much upon the method of pruning followed. If the trees are headed in vigorously and systematically they may be set one-fourth or one-third closer than if allowed to grow to their natural size. Heading in should always be practiced with dwarf pears and many of our best orchardists head in their peaches, plums, and quinces. Thin planting is the safer rule for the majority of cases. The following distances are

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about the best on the average land in Oklahoma when the trees are allowed to grow to their full size:

Apples 30 to 35 feet each way.
Pears, stanadard, 20 to 25 feet.
Pears, dwarf, 12 to 16 feet.
Peaches and nectarines 20 to 24 feet.
Plums and apricots 20 feet.
Cherries 20 to 25 feet.
Quinces 16 feet.

Short-lived or early-bearing trees are often planted between apple trees. This is sometimes practiced with good results but usually it is a bad practice and results in permanent harm to the orchard. While the orchard is young there is some unoccupied land that may be planted to some hoed crop but this land is all needed by the apple trees by the time earlier bearing trees become productive. There is not one man in a dozen who will cut out the trees that are bearing fruit before they have done permanent harm to the apple trees. This applies as well to planting blackberries and the like between orchard trees of any kind. The roots of trees spread over a much larger area than the top and the roots will be overlapping and robbing the slower-growing trees long before there seems to be any danger of crowding. The thickly planted orchard will be more difficult to cultivate and keep in good condition.

There are many methods of laying off the land in preparation to setting the trees. A simple method is to lay off the rows in both directions with a lister or stirring plow. The trees can then be placed at the intersection of the two furrows and placed in line with but little work. The plow can be run deep enough so that only a little soil will have to be moved in order to place the tree. If the top soil is shallow and underlaid with a hard clay subsoil the hole for the tree should be made much larger and filled with surface soil.

The trees should be set at the same depth or a little deeper than they stood in the nursery row. If set too shallow the crown and roots are exposed to the dry soil and air and the tree is almost sure to perish. If set too deep the roots will be in cold earth and will not start into growth until long after the buds have started. This causes the tree to start growth in the early spring and then die as soon as dry weather sets in.

The soil should be firmed well around the roots and base of

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the tree to keep the roots from drying and hold the tree firmly in position. It is a good plan to lean the tree a little toward the direction of the prevailing wind. The tree should not lean more than two inches to the foot from a perpendicular line. If it leans too much it will make a very badly shaped head.

WRAPPING THE TREES.

The rabbits damage and kill a great many young trees during the winter by peeling the bark from the trunk and lower limbs. There are several methods of protecting the trees, the most common of which is to wrap the tree with corn stalks, hay, or heavy paper. Wire netting is sometimes used but it is too expensive for most such work. The aim is to wrap the tree so that rabbits cannot reach the bark. This method of wrapping trees proves very effective and is well worth the doing. Some of these protectors if properly fastened, may be left on all summer to shield the tree from the hot sun. The binding must not be tight or it will choke the tree, but simply close enough to hold the covering in place. The wrapping of corn stalks or similar material is the best if it is left on all summer. The stalks are cut diagonally and stuck into the ground as close to each other as they can be set. The top is held in place by wrapping with a wire or heavy twine. This does not form a good breeding place for the borers as is commonly supposed. There can almost always be some bugs found hiding in such places but they are usually harmless. The borers are always worse in trees that suffer from sunscald and drouth and seldom bother well-protected and fast-growing trees.

WASHING TREES.

Washing trees with soft soap or blood to protect from rabbits is often quite effectual. Washing trees with blood is not practicable in large orchards but can easily be done two or three times each winter on the average farm. This operation depends on making the bark distasteful to the rabbits so that they will not bother the trees. This method is cheap and in many cases has proven entirely satisfactory.

The practice of washing the trees with some kind of strong solution during the spring and summer is looked upon by many as one of the necessary operations in good care of the orchard. The object of this wash is to keep the trunk of the tree free from in-

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sects and diseases. It may be a benefit to the tree by softening the dry hard bark on stunted and bark-bound trees. Most washes are used for the purpose of protecting the tree from the attacks of borers and for such purpose the value of many washes is doubtful. Soft soap is one of the best washes for young trees. It is cheap, easily made, and can be made by any one. One pound of concentrated lye dissolved in two galons of water is also a very good wash. Neither of these washes will entirely prevent borers and should be used only as one of the operations of cultivation and care necessary to keep the trees in a healthy growing condition.

PRUNING THE TREES.

Apple trees require pruning from the time they are set in the orchard until they cease to be of value as orchard trees. The roots necessarily receive severe pruning when the trees are lifted from the nursery row; the larger portion of the roots remaining in the ground. The roots that are broken and mashed should be removed and the ends of all roots cut clean and smooth up to sound bark. This will put them in much better condition to heal over quickly. It is best to leave as much of the roots on the tree as possible and not to prune them any more than is necessary to put them in good condition. The top should be cut back severely to balance the relation between the leaf surface and the roots. The limbs can be cut back, leaving only four to ten inches of each limb. If there are more limbs than are wanted to form the main frame work of the top, the extra limbs should be cut out entirely.

There should not be more than five or six main limbs. The top can branch from these and be formed better and with less danger of interfering branches. The first two years after the trees are set in the orchard is the time to form the frame work of the top and if the tree is cared for and pruned properly during this time, the future pruning will be light and easily done. It will consist of removing interfering twigs and thinning the top to admit air and sunlight.

The head of the tree should be formed low, the lower limbs about two feet from the ground. The low headed trees shade the trunk and surrounding soil very early in the life of the tree and in this way form a great protection against sunscald. The low headed trees are not so badly beaten and shaken by the wind. This point is perhaps of greater value than that of protecting from sunscald. This is equally true of all kinds of orchard trees.

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Pear trees should be pruned the same as apple trees for the first five or six years. After the tree comes into bearing the top must be cut back each year. This is especially true of dwarf pears, where heavy pruning is one of the conditions that help to keep the tree dwarf. The fruit-buds are formed on the end of twigs or spurs and it seldom happens that a twig bears fruit and develops a fruit bud the same year. Cutting back the top during the winter will cause the tree to develop a larger number of fruit buds each year.

Peaches and apricot trees should be set when one or two years old from the bud. When the trees are set, the roots are pruned no more than is necessary to put them in good condition and the top is pruned to almost a straight stick. The side branches are cut back to two or three buds and the central stem is cut back to not more than two or three feet in length. The frame work of the tree should be formed about the same as that of the apple tree. The trees should be pruned each year to obtain the best fruit. The trees nearly always set more fruit than they can mature and unless the fruit is thinned it will be small and of poor quality. The trees should be headed in during the winter each year. This heading in consists of cutting back the longest and strongest branches and usually aims to remove about one-half of last year's wood. This serves the purpose of thinning the fruit and keeping the tree within bounds.

Plum trees should be cut back about the same as peach trees when set. The subsequent pruning is more like that given the apple. The trees require only a little pruning to keep the top open to admit light and air. The branches may be cut back the same as peach trees and it will answer the same purpose with the American varieties only to a less extent. The Japan varieties bear their fruit in spurs and for that reason should be pruned the same as apple trees.

Cherry trees should be pruned for setting about the same as the peach. The care given all trees in forming the head is applicable to the cherry. After the frame work for the head is started right the trees will require little pruning beyond that necessary to remove interfering branches.

SPRAYING.

Spraying if properly done will prevent the attacks of most plant diseases but will cure plants of very few diseases after the

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disease has gained a foothold on the plant. To spray for each and every plant disease would be an almost endless task. Fortunately about ninety per cent. of all the diseases that can be prevented by spraying require about the same treatment. Four good sprayings a year will keep most orchards free from disease. The first application should be given before the buds start in the spring; the second as soon as the flowers have dropped; the third about two weeks after the second, and the fourth two or three weeks later. The following solution is the one in most common use and seems as well adapted for all special cases as for general use. The copper compound is the active part against diseases and the Paris green against eating insects:

Bordeaux mixture and Paris green.
Copper sulfate (blue vitriol) 4 pounds.
Quicklime (not air slacked) 4 pounds.
Water, to make 50 gallons.

Dissolve the copper sulfate in about two gallons of hot water, contained in a wooden vessel, by stirring, or even better, by suspending the sulfate contained in a cheese cloth sack, in a large bucketful of cold water. With the cold water and cheese cloth bag, a longer time is required. Pour the sulfate solution into the barrel or tank used for spraying, and fill one-third to one-half full of water. Slake the lime by addition of a small quantity of water, and when slacked cover freely with water and stir. Pour the milk of lime thus made into the copper sulfate, straining it through a brass wire strainer of about 30 meshes to the inch. Pour more water over the remaining lime, stir and pour into the other; repeat this operation until all the lime, but stone lumps or sand is shaken up in the milk of lime. Now add water to make 50 gallons in the tank and add four ounces of Paris green or London purple. After thorough agitation, the mixture is ready to apply. The mixture must be made fresh before using and any left over for a time, should be thrown out or fresh lime added.

Insects that have sucking mouth-parts cannot be killed with Paris green or London purple and should be sprayed with kerosene emulsion which kills by contact.

KEROSENE EMULSION.

Dissolve one-half pound hard soap in one gallon of water (preferably soft water) and while still hot remove from the fire and add two gallons of kerosene. When soft soap is used, take equal quan-

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tities of soap and oil and omit the water before mixing. Stir the mixture violently by driving it through a force pump back into the vessel, until it becomes a creamy mass that will not separate. This requires usually from five to ten minutes. The emulsion is then ready to be diluted with water and applied. For the common scale insects and hard bodied insects, like chinch bugs use 1 part emulsion to 8 or 10 parts water. For soft bodied insects (plant lice, etc.) use 1 part emulsion to 15 or 20 parts water.

Spraying is not a fad but as necessary an operation in successful fruit growing as cultivation or pruning.

WIND-BREAKS.

Wind-breaks should be provided for the orchard and berry patches. The south and west sides should be protected by planting of trees near the edge of the orchard. The south and southwest winds have the greatest effect upon the trees and are about the only winds that do much harm to the orchard. There is time and labor connected with the planting and care of the wind-break but they are well worth their cost.

A wind-break reduces the evaporation of water from the surface of the soil thus tending to mitigate drought in summer and root-injury in winter. The value of the wind-break for this purpose can hardly be over estimated. Enormous quantities of water are carried away from the land by the dry south winds and anything that will check their force will conserve the moisture to a great extent.

Wind-breaks lessen the amount of wind-fall fruit. It is the hard gales that shake so many immature fruits from the trees. A wind-break lessens the breaking of trees loaded with fruit. It also enables the trees to grow straighter. These are not all of the benefits to be derived from wind-breaks although they are the most important ones.

The following are the most common injuries resulting from a wind-break.

Fruit immediately adjoining the wind-break is apt to be much injured by insects and diseases and to be small and inferior in color. Trees immediately adjoining the wind-break are often less thrifty than others. A few other injuries are sometimes charged up to the wind-break but they are not very important. The first injuries just mentioned can be met and overcome by a little work with the spray pump, which must be performed whether there is a wind-

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break near-by or not. The second class of injuries is caused by the wind-break being placed too near the plantation and is not a fault of the plantation in itself.

The best form of wind-break is perhaps formed by setting trees four or five feet apart in rows that are about five feet apart. There should be a space of thirty feet, and forty feet would be better, between the orchard and the wind-break. Some kind of fast growing trees should be used. The elm, soft maple, catalpa, and mulberry are good trees for this purpose. The best results will be obtained if the wind-break can be set two or three years before the orchard. The wind-break if properly cared for will also furnish a constant supply of posts and fire wood. Black locusts grow rapidly and make a good wind-break as well as furnish excellent posts. There is, however, some possibility of their being attacked by borers, as in Kansas, though up to this time, no trouble from this source has been experienced.

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VARIETY TESTS OF FRUITS.

O. M. Morris.

APPLES.

The following varieties set fruit in 1901:

Alexander, Arkansas Beauty, Arkansas Black, Baldwin, Babbitt, Black's Annette, Black Warrior, Bledsoe, Carolina Red June, Carolina Watson, Charlotton Thaler, Chester's Early White, Cole's Quince, Cooper's Early White, Cullen's Keeper, Dickinson, Dr. Walker, Duchess, Duchess of Oldenburgh, Enormous, Fallawater, Fanny, Fenley, Gano, Haas, Hightop Sweet, Jefferis, Jewett's Best, Jones' Seedling, Kentucky Red Streak, Large Yellow Bough, Late Strawberry, Limbertwig, Little Romanite, Lowell, Maiden's Blush, Mammoth Black Twig, May Pippin, Maverack, Missouri Pippin, Nantahallee, Nickajack, Northern Sweet, Oldenburgh, Orchard Red, Plumb's Cider, Primate, Pyle's Red Winter, Red Bietigheimer, Shockley, Simmon's Red, St. Lawrence, Stewart's Golden, Stump, Trenton Early, Twenty Ounce, Wagener, Water, White Juneating, White Spanish Reinette, Winesap, Yopp's Favorite.

The following varieties bloomed but set no fruit:

American Summer Pearmain, Indian, Kansas Queen, King, Moon, Nero, and Vandevere.

PEARS.

The following varieties set fruit in 1901:

Bartlett, Clapp's Favorite, Duchess, Early Harvest, Keiffer.

CHERRIES.

The following varieties set fruit in 1901:

Belle de Choisy, Dyehouse, Early Richmond, English Morello, Montmorency, Olivet.

PLUMS.

The following varieties set fruit in 1901:

Beauty, Botan, Burbank, Emerson, Forest Garden, Golden, Hattonkin, Mrs. Clifford, Newton, Ogon, Pottawatomie, Weaver,

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Wolf's Free Stone, Wooton, and Yosebe. Lone Star and Satsuma bloomed but set no fruit.

APRICOTS.

The following varieties set fruit in 1901:

Alexander, Early Golden, Gibb, Golden Russian, J. L. Budd, Jackson, Luizet, and Oldenburgh.

PEACHES.

The following varieties set fruit in 1901:

Alexander, Alice Haupt, Arkansas Traveler, Barnes, Becquett's Cling, Becquett's Free, Bell's October, Bishop, Bonanza, Champion, Cobbler, Crimson Beauty, Crothers, Druid Hill, Early Rivers, Early York, Eldred Cling, Gen. Taylor, Haynes' Surprise, Heath Free, I. B. Cling, June Rose, Mamie Ross, Miss Lolo, Mountain Rose, Mrs. Brett, Raisin, Ringold, Salway, Scruggs, Stump, Sylphide, Thurber, Topaz, Utah Cling, Walker, Wonderful, and Yellow St. John.

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TREE PLANTING.

O. M. Morris.

The following summary of trees set in February 1900, is of interest. The yearling seedlings were set in rows four feet apart and from two to four feet apart in the row, on a piece of rough land not suitable for farm crops.

KIND	No. Set	No. Living June 1, 1901.	Per cent. Dead.
White Elm	9,000	7,625	15
Soft Maple	5,000	4,800	4
Catalpa	5,000	4,725	5
Black Locust	5 000	4,850	3
Box Elder	5,000	4,000	20
White Ash	3,000	800	73
Honey Locust	3.000	1,000	67

The elms were in poor condition when set out and under normal conditions, a larger percentage would probably survive. The seedlings were purchased at a cost of $3.00 per thousand.

Clean cultivation is given so long as it is possible to get through the rows with a horse. A portion of the planting is trimmed and thinned as the trees become larger, another is trimmed but not thinned, and another is allowed to grow without attention. The different kinds are planted after a definite plan and arranged so as to furnish data later as to the effect of environment on the growth.

The black locust has made the strongest growth, catalpa and maple about equal, with the box elder third, elms fourth and honey locust fifth, ash least of all. The strongest growing trees, black locust, thrive best in mixed plantings, but all of the others do best in solid plantings.

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WHEAT PASTURE.

A. B. McReynolds.

For the purpose of comparing the value of growing wheat as pasture with several of the most common grasses grown for pasture, and preliminary to further work on the subject, two samples were collected February 27, 1901.

Sample number 2526 was taken from a plat of medium early seeding. The plants from three square yards were carefully cut, just above the ground. The total yield of the green plant from three square yards was at the rate of 4679 lbs. per acre.

Sample number 2527 was taken from a plat of early seeding, as above, and the weight of green wheat from two square yards was at the rate of 8857 lbs. per acre.

Number 2526 was for the most part green and fresh when sampled, while 2527 had lost nearly all of its coloring matter.

Calculated from the results which follow the yield of dry matter from the wheat plant at the end of the pasture period in a very favorable season was, in the first case 1680 and in the second 3608 lbs. per acre.

Holter, (Pa. Expt. Sta. Report, 1889, p. 99), as the result of a study of "blue grass mixed with white clover" found a yield of 1,612.91 lbs. of dry matter per acre "under the most favorable conditions for the growth of grass, that is a very heavy and evenly distributed rainfall."

The following table summarizes the results of analyses of these samples and the composition of some pasture grasses:

SAMPLE	Water in Fresh Substance	Composition of Dry Matter					Source of Analysis
		Ash	Protein	Fiber	N-Free Extract	Ether Extract	
No. 2526 Wheat Plant	64 10	14 35	18 94	13 18	51 45	2 08	Original
No. 2527 " "	59 24	13 20	16 06	18 27	50 52	1 95	Original
Kentucky Blue Grass	54 58	6 08	9 02	25 13	56 85	2 92	Ky. Ex. Sta B. 87
Orchard Grass	69 15	6 52	7 62	35 12	48 39	2 35	Ky. Ex. Sta. B. 87
Eng. Blue Grass	65 33	7 23	8 58	33 84	48 12	2 23	Ky. Ex. Sta. B. 87
Timothy	59 90	5 14	6 95	31 00	54 65	2 26	Ky. Ex. Sta. B. 87
Red-top	59 74	6 05	6 77	30 78	54 25	2 15	Ky. Ex. Sta. B. 87
Ky. Blue Grass and White Clov'r	71 80	8 45	23 32	18 59	43 79	5 85	Pa. Ex. Sta. R. '89

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While the available data are not sufficient for a satisfactory comparison of wheat pasture with the usual pasture grasses, the comparison of yields given and the composition of the growing wheat plant serve to explain in part the reasons for the high esteem in which Oklahoma farmers hold wheat pasture. The percentage of protein is much higher than in the ordinary grasses. In seasons similar to the winter of 1900-01, wheat sown for the grain will yield a large amount of highly nutritious forage. Wheat sown for pasture alone rarely failed to yield a profit in the way of vigorous growth of young stock and good yields of milk from dairy animals. Wheat solves, in a large measure, the problem of providing winter forage here and the further extension of its use for this purpose gives promise of greater profit.

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FINANCIAL REPORT OF THE OKLAHOMA AGRICULTURAL EXPERIMENT STATION.

FOR THE YEAR ENDING JUNE 30, 1901.

Dr.

To Receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1901, as per Act of Congress approved March 2, 1887, $15000.00.

Cr.

By Salaries	1	$ 5430.00
Labor	2	2496.85
Publications	3	2046.64
Postage and Stationery	4	426.54
Freight and Express	5	215.41
Heat, Light and Water	6	472.06
Chemical Supplies	7	328.70
Seeds, Plants and Sundry Supplies	8	274.08
Feeding Stuffs	10	605.99
Library	11	134,38
Tools, Implements and Machinery	12	308.98
Furniture and Fixtures	13	549.86
Scientific Apparatus	14	30.07
Live Stock	15	450.00
Traveling Expenses	16	452.44
Contingent Expenses	17	28.00
Building and Repairs	18	750.00
Total		$15000.00

We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the Oklahoma Agricultural Experiment Station for the fiscal year ending June 30, 1901; that we have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $15000.00

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and the corresponding disbursements $15000; for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving no balance.

And we further certify that the expenditures have been solely for the purposes set forth in the Act of Congress approved March 2, 1887.

(Signed:)

FRANK J. WIKOFF,
C. J. BENSON,
WILLIAM M. JENKINS,
Auditors.

Attest:

HENRY M. HAND, Custodian.

SUPPLEMENTARY STATEMENT.

Receipts and disbursements of Station Sale Fund.

Dr.

July 1, 1900, Balance	$ 924.84
To receipts from sale of station products	2000.00
Total	$2,924.84

Cr.

By Labor	$ 771.24
Postage and Stationery	0.45
Freight and Express	7.15
Heat, Light and Water	338.03
Seeds, Plants and Sundry Supplies	3.85
Feeding Stuffs	480.35
Tools, Implements and Machinery	25.90
Furniture and Fixtures	30.86
Traveling Expenses	32.95
Contingent Expenses	2.50
Building and Repairs	392.63
Balance	838.93
Total	$2924.84

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PUBLICATIONS.

A few copies of each of the following publications are still on hand and will be sent in response to requests so long as the supply lasts.

Annual Report, 1898-99.—Summary of results of previous work of the station.

No. 43, Nov. 1899—Fruits for Oklahoma.

No. 44, Dec. 1899—Field crops, 1899.

No. 45, Mar. 1900—An Annotated catalogue of the ferns and flowering plants of Oklahoma.

No. 46, May, 1900—Digestion trials.

Annual Report, 1899-1900.

No. 47, Sept. 1900—Reports of wheat raisers; Experiments with wheat.

No. 48, Dec. 1900—Crop and forage notes, 1900.

No. 49, Feb. 1901—A rhizomorphic root-rot of fruit trees.

No. 50, Apr. 1901—Manuring the soil.

Address all requests to

EXPERIMENT STATION,

Stillwater, Okla.

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INDEX.

A.

Admission to college 12
Agricultural department, college 9
Alfalfa for beef making 98-101
Annual precipitation 86-97
Apple leaf rust 116-117
root-rot 39-44
varieties 136-147
Apricot varieties 137-148
Artichokes for hog pasture 35
Asparagus 50-51

B.

Bag worm 57
Beef making 98-101
Bee keeping 61
Blackberry bushes 45-46
Blackleg 88-97
vaccine 35
Board of Regents 4
Borers in trees 53-54
Botany and entomology, college 9
Breeds of fowls 71-73
Buildings 16
Bulletins issued 16
Buying fruit trees 36, 138-139

C.

Cabbage bug 113
Cattle feeding experiments 29
Cereal rusts 117-118
Chemistry department, college 8
Cherry tree aphis 114
varieties 137-147
Chicken cholera 82-83
Chinch bugs 55-57
false 114-116
Corn for beef-making 98-101
smut 124-127
Correspondence 17
Cottonseed and cottonseed meal 30
Cottonseed meal as pig feed 102-107
Courses of study in college 10
Cover crops for orchard 134
Cowpea hay for swine 108-111
Cowpeas for hog pasture 34
Crop and forage notes 27-28
Cropping the orchard 133

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D.

Director's report 13-18
Dressing and shipping poultry 84

E.

Equipment of college 8
Expenses of going to college 12

F.

Faculty of college 10
False chinch bugs 114-116
Farmers' institutes 17
Farm poultry keeping 63-85
Feeding fowls 73-79
Field peas 32
Financial statement 152-153
Free seeds 62
Fruit diseases 44-45
.trees, buying 36

G.

Gapes in chickens 82
Garden notes 48
Grain louse 59-61
Grapes vines, pruning 47

H.

Hessian fly 58-59
Hog cholera 36
Horticultural department, college 9

I.

Insects in stored grain 54-55
notes 52-53
troublesome 112-116

K.

Kafir corn for beef-making 98-101

L.

Letter of transmittal 5
Lettuce and radishes 48-49
Library 8
Location of orchard 129-130

M.

Mailing list 17
Manuring the orchard 135
soil 23
Marketing small fruits 47-48

Digitized by Google

Mechanical department, college 8
Melon louse 57-112
Mulch strawberries 47

N.

Nankeen cotton 25
New and remarkable plants 37

O.

Onion growing 51
Orchard, the 129-146

P.

Pasture crops for hogs 30-35
Peach varieties 137-148
Peanuts for hog pasture 34
Pear varieties 136
Pig feeding with cotton seed meal 102-107
cowpea hay 108-111
Pigs following steers 100-101
Plant diseases 123
Plant shade trees 38
trees for posts 38
Plum varieties 137-147
Poultry keeping 63-85
Preparatory department 12
Preparation of land for orchard 130-132
Press bulleting 19-62
Prevention of black-leg 88
Progress of college 7
Protect blackberry bushes 45-46
Pruning fruit trees 142-143
grape vines 47

R.

Radishes 48-49
Rainfall 86-87
Rape for hog pasture 32-33
Resources of college 7
Rhubarb 49-50
Root-rot of fruit trees 39-44

S.

San Jose scale 57-58
Setting fruit trees 139-141
Short winter courses 11-62
Smuts of the cereals 118-128
Sorghum for hog pasture 34
smut 127
Sparrows eat grapes 51-52
Spraying fruit trees 143-147
Station staff 4-13
Strawberries, mulch 46

Digitized by Google

Subjects of investigation 13-15
Sugar beets 29
Summary of press bulletins 19-62
Sweet potatoes for hog pasture 35

T.

Tools used in orchard cultivation 132-133
Treatment of blackleg 93
Tree planting 149
Trees for posts 38
shade 39
Troublesome insects 112-116

V.

Vaccination for blackleg 94-97
Varieties of fruit 135-138
wheat 22
Variety tests of fruit 147-148
Veterinary science, college 9

W.

Washing fruit trees 141-142
Wheat, continuous 20
crop 26-27
experiments 19-22
pasture 150-151
raising 22-26
time of seeding 21
varieties 22
Windbreaks 145-146
Wrapping fruit trees 141

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OKLAHOMA

AGRICULTURAL and MECHANICAL

COLLEGE.

Agricultural Experiment Station.

Eleventh Annual Report, 1901-1902.

Stillwater, Oklahoma.

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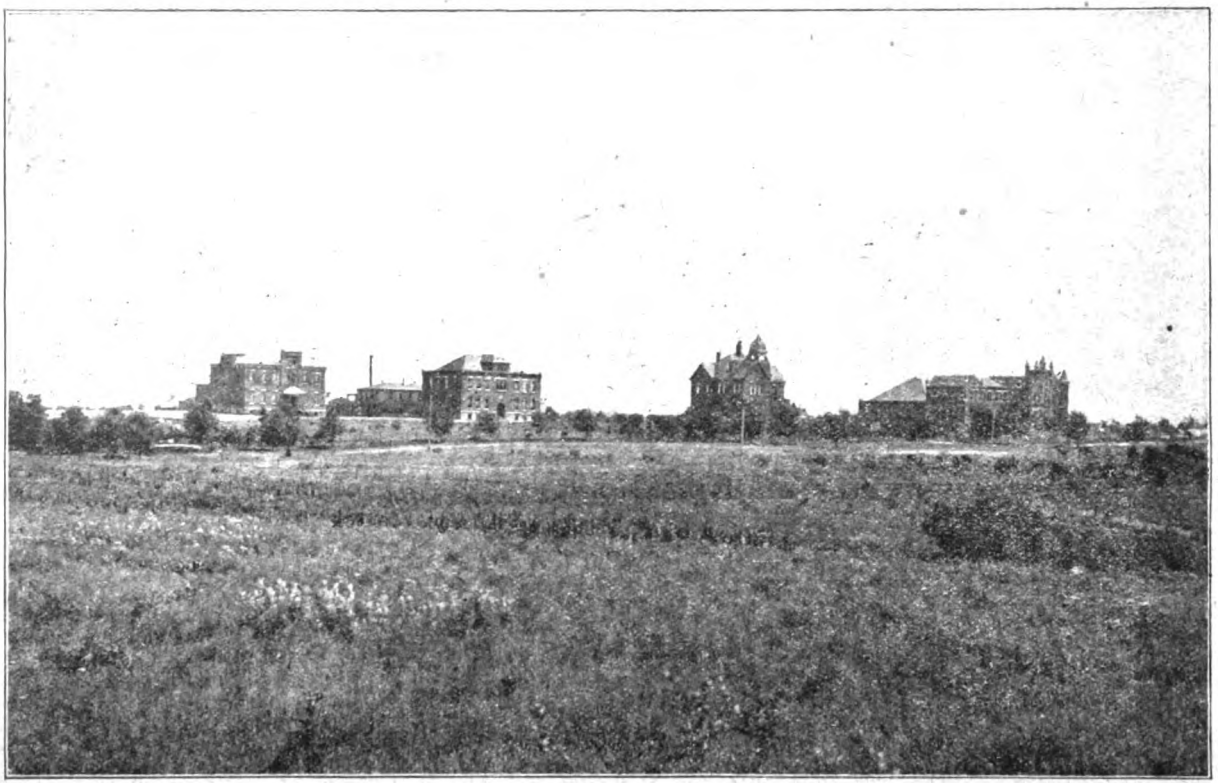

BUILDINGS AND CAMPUS.

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OKLAHOMA

AGRICULTURAL and MECHANICAL

COLLEGE.

Agricultural Experiment Station.

Eleventh Annual Report, 1901-1902.

Stillwater, Oklahoma.

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Oklahoma Agricultural and Mechanical College.

AGRICULTURAL EXPERIMENT STATION.

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A. B. MCREYNOLDS, B. S.....Assistant in Chemistry
J. S. MALONE, B. S.....Assistant in Agriculture
H. M. HAND.....Clerk
MISS G. M. HOLT.....Stenographer

VISITORS ARE CORDIALLY WELCOMED AT ALL TIMES.

The publications of the Station are sent free to residents of the Territory on request. All communications should be addressed, not to individuals or departments but to the

EXPERIMENT STATION, Stillwater, Oklahoma.

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EXCHANGE
MICHIGAN STATE College

MAR 22 '40

LETTER OF TRANSMITTAL.

Stillwater, Oklahoma, July 1, 1902.

Sir:—

I submit herewith the eleventh annual report of the Oklahoma Agricultural Experiment Station, for the fiscal year ending June 30, 1902. In addition to the statement of the work which has been done during the year, and the financial statement as required by law, the report contains several articles on subjects that have a direct bearing on the agricultural interests of the Territory.

Very respectfully,

Governor T. B. Ferguson,
Guthrie, Oklahoma.

John Fields,
Director.

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Oklahoma Agricultural and Mechanical College.

PROGRESS.

The growth noted in the last report continues in a very satisfactory degree. The student body has increased in number to 435, and the equipment for instruction, outside of buildings, to a valuation of approximately $80,000. The building equipment has practically doubled within the year, standing now at a valuation of about $100,000.

RESOURCES.

The Oklahoma Agricultural and Mechanical College receives from the government every year the sum of $22,500. This is known as the "Morrill Fund," and is to be expended for instruction and appliances only, the Territory of Oklahoma providing buildings, repairs, etc.

The Agricultural Experiment Station, which is a department of the college, receives from the United States government, an annual appropriation of $15,000, to be used solely for experimentation and the publication of results. This is known as the "Hatch Fund."

The territorial law provides for the annual levy of one-tenth of a mill on the taxable property of the territory for the benefit of the college. This, on present valuations, reaches about $6,000. The law also sets apart one-fifth of the income derived from the rental on the lands granted to the territory for the benefit of the institutions of higher learning This amounts to about $7,500 per year.

There are other slight sources of income, not necessary to detail here, which raise the total annual income of the college and station to about $53,000.

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Equipment—Grounds and Buildings.

The college campus, farm, and experiment station gounds occupy 200 acres of land. At the opening of the next academic year, September, 1902, four chief buildings and four minor buildings will be occupied for purposes of instruction. Since the last report was issued the following additions have been made to the building equipment: An auditorium with present seating capacity of eight hundred, ultimate capacity of twelve hundred; quarters for the department of botany and entomology; quarters for the department of domestic economy; building for the department of mechanical engineering; boiler house and smokestack; and a commodious barn for the college farm.

Library.

The college has a well selected library containing 8,000 bound volumes and 11,000 pamphlets. The books are kept in a fire-proof stack room, and a pleasant and commodious reading room is provided immediately adjoining. Students are permitted under proper restrictions to take books to their rooms. The best reference books and the leading periodical publications are at the disposal of students.

Mechanical Department.

The new engineering building, to be occupied upon the opening of the fall term, will add greatly to the efficiency of this department. The equipment includes a machine shop, a carpenter and pattern making shop, a blacksmith shop, a foundry, and a drawing room, besides the electrical engineering laboratory, all of which are fully provided with the latest and best machinery, instruments, tools, and appliances.

Department of Chemistry.

This department is located in the new chemistry building, occupying the basement, a lecture room, quantitative laboratory, and offices on the first floor, the entire second floor, and the attic—the remainder of the building being occupied by the experiment station. The qualitative, quantitative, and private laboratories are fitted for the best service, and the department is equipped with the best modern apparatus, glassware, chemicals, analytical and assay balances, etc.

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Pressure of numbers has already rendered necessary the equipping of an additional laboratory in the new building.

Department of Botany and Entomology.

The apparatus in this department is all of recent make and of the best to be found on the market—including 28 simple and compound microscopes, hand lenses, microphotographic apparatus, camera facilities and slide mounts, collections of plants, insects, woods, fibers, seeds, etc.; wall charts, models, etc. The department will move into new and well arranged quarters in the library building at the opening of the fall term.

Department of Zoology and Veterinary Science.

The quarters of this department in the library building consist of a laboratory for general biological work, a bacteriological laboratory, a laboratory for experiment station work, a laboratory for special work, and a lecture room. Among the extensive equipment of the department are twenty compound Zeiss and Leitz microscopes, micrometers and cameras, microtomes, dissecting instruments, dissectible models of various types of animals, skeletons, prepared skins of birds and mammals, etc.

Department of Agriculture.

The equipment of this department has been greatly increased during the year. A two-story brick barn, 60x96 feet, has been erected which, in addition to providing storage space for hay and grain and stabling for live stock, contains a room for stock judging. The farm of 200 acres, with the experiments of the station continually under way, constitutes the laboratory of this department. Four breeds of cattle are represented, viz: Short-horns, Herefords, Aberdeen Angus, and Red Polls. The breeds of swine represented are Berkshires. Poland Chinas; Duroc Jerseys, and Chester Whites; of sheep, Shropshire and Cotswold; horses, Percheron. A farm dairy will be equipped in time for next year's use.

Department of Horticulture.

This department is equipped with complete lines of garden seeders, tools for lawn work, spray pumps, garden tools, charts and models, herbarium, microscopes, etc. It has at its command, also, the

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extensive vineyards and orchards of the experiment station, including fifty thousand trees and vines, and for instruction in forestry, a plantation of forty thousand forest trees.

Department of Domestic Economy.

This department will move into its new and commodious quarters in the Library building at the opening of the fall term in September. The equipment of the department will include a kitchen laboratory, class dining room, two sewing rooms, office and store rooms.

Other Departments.

The departments of English language and literature, of foreign languages, and of history and political economy, are properly supplied with facilities for instruction, and are represented with special fulness in the library. The department of mathematics has extensive appliances for demonstration, instruction, surveying and other practical work. The printing office is suitably equipped for instruction, which is its primary purpose. The regular college publication, The College Paper, is issued by this department, under student management, and the general job work of the college is done by it. The department of stenography and typewriting is equipped with typewriters and other necessary appliances.

Faculty.

The college has a faculty of twenty members, each specially trained in the department under his charge.

Courses of Study.

From the above statement it will be seen that the present facilities of the college are ample to give a high-grade practical higher education. Five courses are offered, all requiring four years (exclusive of the preparatory department) and all leading to the degree of Bachelor of Science:

I.—General Science and Literature course.

II.—Agricultural course—including Horticulture and Veterinary Science.

III.—Mechanical Engineering course—including Electrical Engineering.

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IV.—Courses in Special Sciences.

1. Chemistry.
2. Biology—with majors in botany or zoology.

The branches pursued in the several collegiate courses may be summarized as follows:

Language and Literature.

Rhetoric, etymology and structure, theme work, English and American literature, literary interpretation and criticism: German and Latin.

Mathematics.

Algebra, geometry, descriptive geometry, trigonometry, surveying, analytical geometry, calculus.

Mechanics.

Electricity, magnetism, mechanical drawing, kinematics, steam boilers and engines, thermodynamics, machine design, wood-working, blacksmithing, etc.

Science, Pure and Applied.

Agriculture and horticulture, domestic economy, chemistry, physics, botany, entomology, zoology, comparative anatomy, general biology, physiology, geology, assaying, bacteriology, materia medica, normal and pathological histology, embryology, etc.

Miscellaneous.

Elements of law, political and industrial history of the United States, English history, general history, psychology, sociology, civics, economics, etc.

Short Winter Courses.

During a portion of the winter term, practical instruction is given in matters directly related to farming, stock raising and fruit growing, and the management of steam engines, with special attention to machinery used on farms. Any person over sixteen years of age may take this work, no examination for admission being required. A circular describing the work of these courses in detail will be issued in November. In 1903 they will cover eight weeks,

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from January 6 to February 27. The following list contains the work which will be given at that time:

Principles of Breeding—4 lectures.
Study of Breeds—10 lectures.
Stock Judging—10 hours.
Diseases of Live Stock—18 lectures.
Stock Feeding—12 lectures.
Farm Dairying—9 lectures.
Crops for Oklahoma—18 lectures.
Farm Machinery and Equipment—12 lectures.
Steam Engines and Boilers—8 lectures.
Maintenance of Soil Fertility—9 lectures.
Orchards and Small Fruits—18 lectures.
Troublesome Insects—9 lectures.
Elementary Botany—9 lectures.
Farm Hygiene; Water Supply—10 lectures.
Legislation and Laws Affecting Farmers—12 lectures.
Farm Accounts, Mortgages, etc.—12 lectures.

Work in blacksmithing, steam engines and boilers, veterinary practice, dairying and practical horticulture will be given in the afternoons in so far as the facilities of the college will allow.

The lectures will be supplemented by practical work in the dairy, barns, shops, and orchards, designed to fix and illustrate the methods and practices advised. It is practical instruction throughout and planned to give the most that is possible in so short a time.

OTHER SPECIAL COURSES.

The college also offers instruction in stenography, typewriting, and printing.

ADMISSION TO COLLEGE.

To enter the freshman class the applicant, under the territorial law, must be at least 14 years of age, and must pass a satisfactory examination in the following subjects: Reading, spelling, penmanship, geography, United States History, grammar, and arithmetic. It is urgently recommended also, that he be well prepared in physical geography and civil government, as these subjects are covered in our preparatory department.

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PREPARATORY DEPARTMENT.

In order to meet the wants of those whose school facilities have not been sufficient to prepare them for the collegiate work a preparatory or sub-collegiate course, extending through two years, has been provided, which gives a thorough and approved training in all the branches above mentioned, and in civil government, physical geography, and free-hand drawing. To enter the preparatory department the applicant must be sixteen years of age.

EXPENSES.

Tuition is free. An incidental fee of one dollar per term is charged students entering from Oklahoma and Indian Territories. A fee of five dollars per term is charged students under twenty-one years of age entering from else-where. Text books will cost from $3.00 to $5.00 per term. Special students in stenography and typewriting are charged $2.00 per term for use of typewriter. A deposit of $2.00 a term is required of all students in the Sophomore class in chemistry to cover laboratory breakage.

OPENING.

Entrance examinations for the fall term, 1902, occur September 8–9. Fall term begins September 10. For catalogue and full information address

A. C. Scott, President,
Stillwater, Okla.

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OKLAHOMA AGRICULTURAL EXPERIMENT STATION.

REPORT OF DIRECTOR.

The unusual climatic conditions of the past year brought forward many pressing problems requiring immediate solution and made it necessary to modify plans to some extent to fit the situation incident to a dry year. The table showing the annual precipitation for a series of years printed on another page will serve to indicate the extent of the drouth. Its results were felt in every line of station work. While a misfortune to the agriculture of the territory, the deficiency of precipitation afforded the station an opportunity to study questions which otherwise would not be considered and the year as a whole has been a profitable one to the work of the station.

SUBJECTS OF INVESTIGATION.

The work with field crops covers wheat, corn, cotton, Kafir corn, castor beans, oats, barley, and emmer. Variety tests are made where there yet seems a doubt as to suitable varieties but most of the work is directed toward the study and development of methods of culture adapted to this climate. The moisture in the soil is determined at frequent intervals thus affording valuable data for comparison with the yields which are obtained. The continuous cropping and rotation experiments described in the last annual report of the station are being continued. The present completes the third year of this experiment but a much longer time will be required before results of consequence will be obtained.

Annual forage crops are receiving the share of attention which their importance merits. The manner in which dwarf Essex rape withstood the drouth of last season showed its value and as a result, a large acreage has been sowed by farmers. The arrangement of pasture lots to be described later makes it possible to procure much valuable data and to show the results on a practical scale. Cowpeas, sorghum, peanuts, field peas, oats, wheat, and rye, in addition to rape, are grown for hog pasture. Sugar beets and mangels are also grown for winter feed.

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Experiments with grasses and alfalfa have given some valuable conclusions. Of the grasses thus far tried for pasture, Bermuda grass seems to be the only one that gives promise of success. Small plats of it have been growing on the station farm for ten years and have withstood the winters and hard usage and at the same time, have not spread to a troublesome extent. An effort is now being made to get a stand of Bermuda grass on some high, alkali land not suited for cultivated crops. The dry weather of last summer did not appear to affect the growth of Bermuda grass nor to injure its vitality, while other tame grasses were either killed out or the stand greatly reduced.

While very light crops of alfalfa were secured on the station farm last year, by manuring and disking at proper times, the fields were brought through with an increased rather than a reduced stand and are now in excellent condition, having yielded two heavy cuttings up to June 10th of the present year. This success with alfalfa on land that has a subsoil of stiff, tenacious hard-pan through which the alfalfa roots can scarcely penetrate, if at all, should encourage the seeding of large areas to this valuable crop. The mistake of regarding alfalfa as a pasture rather than a hay crop continues to be made. On a few soils, after a stand of alfalfa is once secured, hogs may be pastured on it with profit. But on the majority of the soils of the territory, pasturing alfalfa serves only to discourage farmers from giving this valuable crop a thorough trial in its legitimate place, as a hay crop.

Because of the high price of corn, Kafir corn, and alfalfa, and of the demand for information concerning the feeding of cottonseed products to steers and hogs, a repetition of experiments with the former was postponed. An outline of the plan of an experiment with steers fed cottonseed products and wheat meal and a brief statement of the results are printed in the summary of press bulletins.

The experiments in feeding cottonseed meal along with other grain to hogs were continued with interesting results. Wheat meal instead of corn meal was used in two trials not yet reported, thus giving further data as to the value and manner of feeding wheat where corn is too high in price to be fed at a profit. A report of this work will appear as a bulletin of the station.

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The station has continued to supply vaccine for the prevention of black-leg in cattle, 123,620 doses having been distributed among 1552 stockmen during the year. This has brought about an appreciation of the efficacy of vaccination and very materially reduced the losses from this disease. In general, excellent results have been reported from the use of the vaccine prepared by the station. An occasional complaint is received that death has resulted after vaccination. Investigation of these cases has nearly always shown that the losses have been due to a careless disregard of the directions furnished by the station. In one case, instead of injecting the vaccine by means of a hypodermic syringe properly sterilized, a slit was cut in the hide and the vaccine was poured in, first from a medicine dropper and when that broke, from a tea spoon. Strange as it may appear, no ill effects followed but the incident serves to illustrate the extent to which directions for using the material are disregarded.

The distribution of black-leg vaccine has continued through three years and has served to acquaint stockmen with the necessity for and efficacy of vaccination. Having accomplished this, which is a legitimate function of the work of the station in distributing information, funds other than those derived from the federal government should be provided for the continuance of the work if it is desired. A vigorous campaign against this disease carried on under the auspices of the territorial livestock sanitary commission would result in practically eradicating it from the herds of the territory.

The parasites of domestic animals have been studied, both in the laboratory and on the farm. A vat suitable for the dipping of hogs and sheep has been constructed and trials are made of various preparations for the destruction of these pests. The results of the work as far as completed have been published as a bulletin of the station.

An investigation of loco plants and the loco disease begun last year has up to this time yielded no practical results. It is planned to continue this work in the hope that some means of ridding the ranges of the plant may be devised and that some treatment for the disease may be discovered.

The experiment with castor beans for the purpose of developing and improving varieties which was begun last year has been ex

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tended and preliminary work with cotton along the same lines is in progress. This work is necessarily slow and to be effective, the interest of practical men must be enlisted. To this end, a bulletin bearing upon the popular side of plant breeding has been issued.

The results of several years of investigation of the potato crop were summarized and issued as a bulletin. Work with potatoes is still being continued with the hope of further improving upon methods of keeping them for winter use. The vineyard and orchard on the station grounds afford much material for the study of fruit production but much use is made of the commercial orchards and vineyards in different parts of the territory. The study of conditions as they are met in practice is found to be far superior to endeavoring to make conditions to order so that they may be studied. The root-rot disease of fruit trees first described in bulletin No. 49 of this station continues causing serious losses. As yet, no further information than that contained in the bulletin is available.

The station has continued giving forestry a large share of attention, both in the way of experimental plantings on the station grounds and in the study of the native timber and commercial plantings elsewhere in the territory. Already results of much value have been obtained and the frequent requests for advice and aid in planting and caring for trees are met by publications of the station, by correspondence, and by consultation with interested persons.

The following tabular statements taken from the records of the horticultural department show the success which is being attained on the upland soil of the station farm:

Set in spring of 1898, cultivated two years;

Kind.	No. Set	Per cent dead Dec. 1st, 1901.	Growth 1901.	Height Jan. 1, '02.
Soft Maple	1500	87	1 ft. 2 in	9 ft. 5 in.
White Elm	1500	*	1 ft. 7 in.	9 ft. 10 in.
Black Locust	333	*	1 ft. 10 in.	16 ft. 10 in.
Catalpa	1599	1	0 ft. 11 in.	9 ft. 10 in.
Hard Maple	2558	78	0 ft. 6 in.	7 ft. 2 in.
Black Birch	511	100		
Wild Cherry	270	6	1 ft. 0 in.	9 ft. 10 in.
White Ash	320	0	2 ft. 0 in.	8 ft. 11 in.

*Some trees removed, record incomplete.

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Set in February, 1900, mixed planting;

Kind.	No Set.	No. Living June 1, 1902.	Per cent dead
White Elm	6690	3345	50
Soft Maple	3964	1585	60
Catalpa	3540	3080	13
Black Locust	4200	3948	6
Box Elder	1880	564	70
White Ash	2001	440	78
Honey Locust	2200	438	80

Set in February, 1900, solid planting;

Kind.	No. Set.	No. Living June 1, 1902.	Per cent dead.
White Elm	2310	1871	19
Soft Maple	1036	1015	2
Catalpa	560	529	5
Black Locust	800	678	15
Box Elder	1120	297	73
White Ash	999	357	64
Honey Locust	800	562	29

The planting of trees for shade on the college and station grounds has been given considerable attention with good scccess. For general plantings of this character, it appears that alternating the white elm with the black locust will probably be found the most satisfactory. The locusts make a rapid growth and furnish quick shade while the permanency and beauty of the elm place it at the head of the list for shade.

Bulletins Issued.

The following bulletins have been issued during the year:

No. 51, December, 1901.

Feeding Cottonseed meal to Hogs, by F.C. Burtis and J. S. Malone.

A statement of the results of an experiment in fattening hogs on rations containing cottonseed meal fed continuously and intermittently in comparison with corn meal and a mixture of corn meal and wheat middlings.

No. 52, December, 1901.

The Potato Crop, Variety Tests of Cabbage, by O. M. Morris.

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A statement of the methods practiced by potato growers in Pottawatomie county and of the results of experiments in growing and storing potatoes carried out at the station. A summary of the results of variety tests of cabbage extending through two years.

No. 53, June, 1902.

Common Parasites of Domestic Animals, by L. L. Lewis.

A description with illustrations of the parasites most common in the territory together with suggested remedies for their destruction and an illustration of a dipping vat for hogs and sheep.

No. 54, June, 1902.

The Improvement of the Castor Plant, by W. R. Shaw.

A popular statement of the purposes of an experiment in plant breeding now being conducted by the station and of the methods of seed selection and improvement which may be employed to advantage by farmers generally.

Press Bulletins, Nos. 74 to 85.

These are summarized elsewhere in this report.

BUILDINGS.

The erection of a new barn for the use of the college and station has afford needed relief. Hitherto, the experiments in feeding have been carried but under difficulties because of lack of space in which to store rough feed and advance supplies of grain and feeding stuffs. The facilities now at hand meet the requirements for the work in feeding. The accompanying diagram shows the arrangement of the buildings, feed and pasture lots, and driveways on the farm. Fences of different patterns and makes have been used in enclosing the lots so that they may be compared under actual conditions of farm practice and that visitors may have an opportunity to examine them.

The construction of an addition to the Library building has provided an excellent laboratory for station work in botany and entomology. The veterinary deparment of the station is on the same floor in the original part of the building. The agricultural department will occupy the basement and one room on the first floor of the Central building during the coming year, the building which it has occupied being moved near the barns to be used as a residence for the

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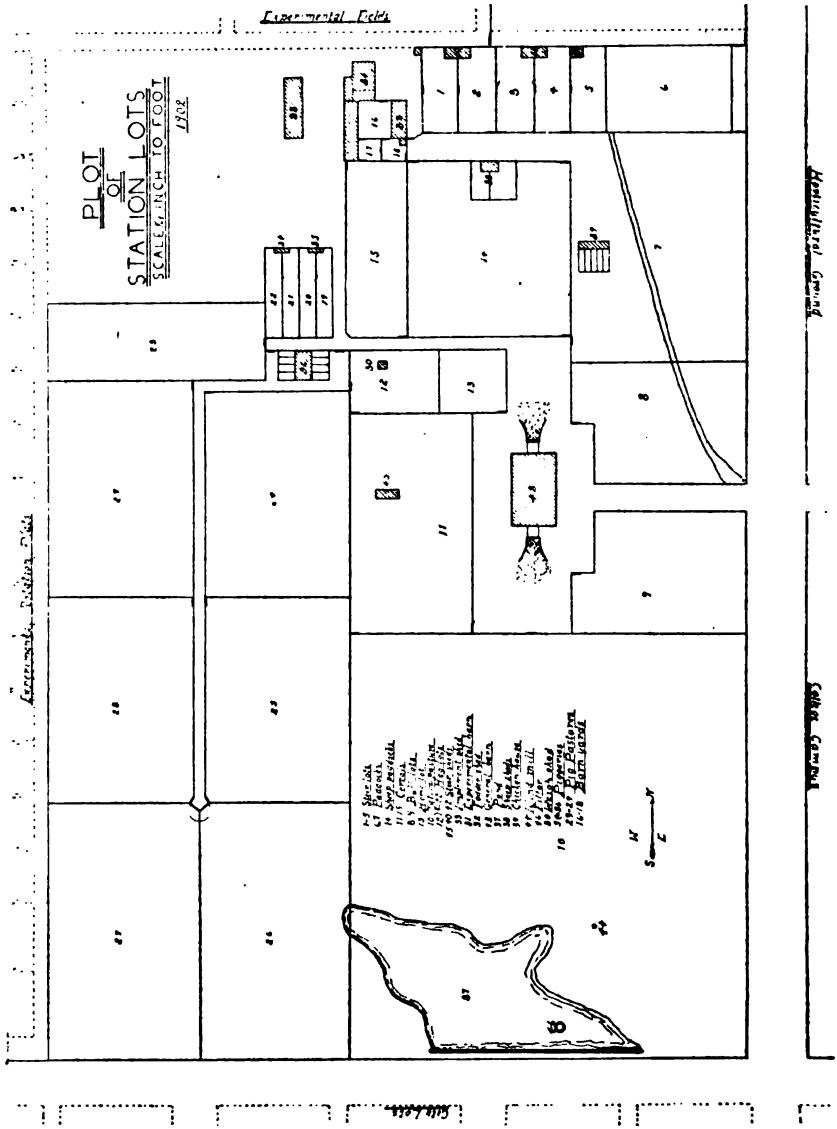

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herdsman. The horticultural department continues to occupy the frame building formerly used as a veterinary laboratory. It would greatly facilitate the work of the station if the agricultural, horticultural, and chemical departments could be provided quarters in a suitable building.

A small building for housing the rabbits used in the study of animal diseases has been provided and needed repairs have been made from time to time.

Mailing List.

The following shows the number of names on the station mailing list, May 1, 1902:

Oklahoma farmers	11729
Indian Territory farmers	3763
Outside list	2422
Local newspapers	237
Outside newspapers	140
Foreign	24
Total	18,315

The publications of the station are sent to all who request them so long as the supply lasts. A list of those still available is printed at the end of this report.

Correspondence.

There has been a continued increase in the correspondence of the station. The printing of press bulletins covering a wide range of subjects about which there is considerable popular inquiry has made it possible to answer many questions more satisfactorily and with less labor than by writing a separate letter for each inquiry.

There has been a continuance of the demand for assays and chemical analyses of all sorts for private individuals. The station does not make assays for gold or silver and can make, without charge, only qualitative examinations of rocks, oils and other minerals. The necessary expense of making quantitative analyses is charged in all cases.

Farmers throughout the territories have enabled the station to extend its work through correspondence and have furnished much

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valuable assistance. In this way, the station keeps in touch with actual conditions in every part of Oklahoma and is enabled to make its work of far greater usefulness than would otherwise be possible.

Farmers' Institutes.

The sixth legislative assembly passed an act providing for the organization of a board of agriculture the members of which are to be elected by delegates from chartered county farmers' institutes. This plan, when in successful operation, will make it possible for the station to render more efficient aid in institute work. All possible assistance was given to those interested in the organization of institutes and the work has been far more profitable than in former years. Thirteen institutes and farmers' meetings were attended by one to three members of the station staff during the year. The importance of these organizations cannot be too strongly urged upon the farmers of Oklahoma and it is hoped that within a short time, the board of agriculture may be organized so that good programs may be arranged for the annual meetings of the institutes.

The Staff.

The only change in the personnel of the station staff during the year was brought about by the resignation of E. M. Wilcox who left October 1, 1901 to accept a position in the Alabama college and station. His work was taken up and has been continued by W. R. Shaw without altering the lines of investigation being pursued.

As heretofore, the work of the different members of the staff has been characterized by a spirit of willingness to work for the best interests of the station as a whole. Each department is engaged in investigations requiring the co-operation and assistance of the others which is cheerfully given without misunderstandings as to whom credit for completed work belongs.

H. M. Hand who has been clerk of the station during the past four years resigned at the close of the year. Miss G. M. Holt, stenographer, has been assigned full work in the college. C. O. Pearcy has been appointed clerk and stenographer. A. G. Ford has been appointed associate chemist of the station succeeding A. B. McReynolds, assistant in chemistry. J. S. Malone has been appointed assistant in animal husbandry and provision has been made for the

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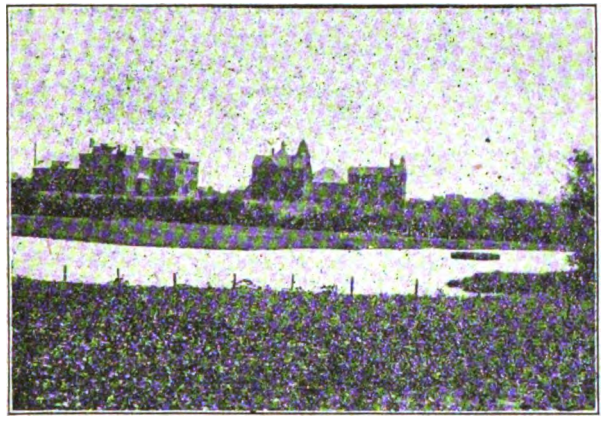
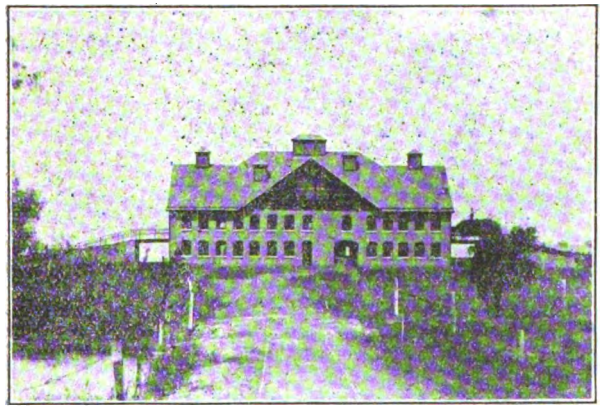
appointment of an assistant in soils and crops, the position of assistant in agriculture having been discontinued.

John Fields,
Director.

June 30, 1902.



VIEW OF GROUNDS.



NEW BARN.

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SUMMARY OF PRESS BULLETINS.

A press bulletin is sent out from the station on about the fifteenth of each month. These bulletins are sent only to newspapers and are intended to contain timely topics related to the work of the station and the agricultural interests of the territory. They are printed in many of the daily, weekly and agricultural papers of the territory and in agricultural papers elsewhere. The station is under obligations to those editors who have assisted in this manner and hereby gratefully acknowledges it. Some of the articles contained in the bulletins may have a permanent value and are reprinted in this report for convenient reference. They are, of necessity, fragmentary and, in part, a repetition of matter contained in regular station bulletins.

WHEAT EXPERIMENTS.

The season of 1900-1901 at the Oklahoma Experiment Station was conducive to another large wheat crop. The yields as a rule are a little better than those of 1899-1900 and the quality of the berry is much better, although last season it was up to the standard.

The early part of the summer furnished fair conditions for plowing but during the latter part the ground was too dry to plow, and up to the 20th of September but a small part of the wheat ground had been stirred and it looked as if the wheat acreage would be small. These extreme conditions were overcome by a rainfall of

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9.22 inches that fell during the last ten days of September. This was followed by good rains during the rest of the fall and the ground was thoroughly soaked and settled and by the middle of November the prospects for a large wheat crop were excellent. The growth was phenomenal and heavy pasturing was required on early seeded wheat to prevent damage from over-growth. We can expect to experience very few such falls where such unfavorable con ditions were so completely changed in so short a time.

The winter was very mild and while the rainfall was light, wheat came through it in excellent condition.

The spring was cold and backward and wheat started much later than usual, but the prospects were good until the April-May drouth struck it. No rain to speak of fell from April 13 to May 18. The growth was much retarded in April, but the critical time was in May when the wheat was heading. The outlook for the crop was very doubtful for many days and much of the crop was damaged. A fine gentle rain of 4.2 inches on May 18 turned the tables again and conditions remained favorable for the balance of the season. Very little damage was done by rust, and chinch bugs were few, and plant lice could not be found in our fields. A dry wheat harvest enabled putting the grain in the bin in the very best condition.

The soil of the college farm is classed as upland and is of average quality. Some of the ground on which the experiments were situated was manured and some was not. All except the variety plats, were one-fourth to one-half acre in size, and these were one twentieth of an acre. The seeding was mostly done the last week in September or the first week in October. All plats were seeded at the rate of one and one-half bushels per acre.

The following are summaries of the results of the various experiments:

EARLY, MEDIUM, AND LATE PLOWING.

This experiment was situated on land that was manured the spring of 1899. It was in corn in 1899 and wheat in 1900. The plan is to make the early plowing about the middle of July, the med-

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ium plowing about the middle of August and the late plowing about the middle of September. The early plowing was performed with ease and was put in good condition with a harrowing. The August plowing was done with the greatest difficulty and was left very lumpy after several floatings and discings. The late plowing was the same as the August plowing. At the usual time of seeding there was a great difference in the condition of plats, but all was made equal by the heavy rain that fell before seeding. In comparison with these plats that were plowed, others were opened up with a corn lister and a crop of cowpea hay was raised on them.

All plats were seeded on October 3 with the disc grain drill at the rate of one and one-half bushels per acre of Fulcaster wheat.

The following are the yields per acre:

Plowed	Grain-Bu.	Straw-Tons	Test
Listed July 11	38.1	1.75	63
July 11	43.6	1.99	63
Aug. 13	38.2	1.74	63
Sept. 13	40.2	1.92	63

That there is no practical difference in the results from the different plats is not surprising since the extra heavy rains in the fall settled the ground of the late plowing and put it in a condition equal to the early plowing. Such a happening as this cannot often be counted on. In 1899-1900 July plowing yielded seven bushels more than August plowing, and sixteen bushels more than the September plowing.

EARLY, MEDIUM, AND LATE SEEDING.

The plan of this experiment is to make three seedings; first about the middle of September, next the middle of October, and last about the middle of November.

The experiment was situated on ground that was manured the spring of 1899. The ground for all the plats was prepared at the same time and in like manner and seeded at the rate of one and one-half bushels of Red Russian wheat.

In all cases the land was in fine tilth at the time of seeding, and the plants made a good start.

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The growth of the September seeding was vigorous and on November 8 it stood eight to twelve inches tall. As this was not desirable two-thirds of each of the September seeded plats were cut with a mower. The tops were left where they fell and in only a few spots did they damage the growth underneath. The cut and the uncut wheat continued to grow vigorously. No bad effects due to the large growth on the uncut portions could be seen in the fall, but when the winter nipped the tops, they wilted down and smothered out patches from one to two feet in diameter and damaged many other portions. It made these portions look very ragged in the spring and during the dry weather they suffered most. The cut and uncut portions were harvested separately and the results are given below.

The October seeding made about the right amount of growth. In the spring all the November seeding had was a single stalk per plant and only about two inches tall. It improved very rapidly as the spring advanced.

The following table gives the yields per acre:

Seeded	Grain-Bu.	Straw-Tons	Test
Sept. 18	36.8	1.45	63
Oct. 20	37 8	1.76	63
Nov. 13	26.8	1.33	61
Seeded Sept. 18	Grain-Bu.	Straw-Tons	Test
Mowed	43 1	1.55	63
Not Mowed	24.1	1.24	62½

The lower yield of the November seeding can be partly accounted for by not enough plants on the ground and partly by the lighter grain due to premature ripening by rust.

It is very seldom that conditions are such that the growth is rank enough on wheat seeded after the middle of September to damage. This need not be expected only on rich soils and in wet falls.

In 1899-1900 September seeding yielded two bushels more per acre than October seeding and thirteen bushels more than November seeding.

WHEAT, CONTINUOUS, WITH AND WITHOUT MANURE.

In this experiment, one half-acre plat is cropped continuously to wheat, and manure is added as thought profitable, while an adjoining half-acre plat is continuously cropped to wheat without the addition of

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any manure. The comparison has been made three seasons. Manure was applied in 1898 at the rate of 15 tons per acre, and in 1899 at the rate of 11 tons.

The following are the yields of grain per acre.

	MANURED	UNMANURED
1898–99	30.6	12.
1899–00	36.8	18.1
1900–01	37.7	28.

The crop of 1900–01 was seeded September 28 with Fultz wheat at the rate of 1½ bushels per acre. Up to the dry spell in April and May the manured plat made much the better showing but the extra heavy growth on this plat suffered more in dry weather than the unmanured plat.

Up to the present time we have obtained an increase of 47 bushels of wheat for something like 26 tons of manure.

VARIETIES

No change was made in the list of wheat varieties that have been grown on the station farm for several years, except the addition of several imported varieties. As in former years, the results of this season demonstrated that there is a large list of wheats of large yielding powers under varying conditions, and there is no single variety that can be said to be the best for all conditions. This season the highest yielding variety was Missouri Blue Stem, 39.6 bushels per acre, and the lowest yield was 29 bushels per acre from Oregon Red.

The following varieties gave 36 or more bushels per acre: Big Frame, Sibley's New Golden, Theiss, Fultz, Early Red Clawson, Early Ripe, Turkey, New Red Wonder. The following varieties fell under 36 bushels and over 32; Crimean, Red Russian, Zimmerman, Big English, Fulcaster, and Pester Boden. One of the new varieties, Weissenburg, was from seed imported from Hungary by the U. S Department of Agriculture. It did not yield quite as much as some of our old varieties, but is quite a promising wheat due to its high milling qualities. Our list also includes the Crimean wheat that the papers are saying so much about now. Both of these are very similar to the old Turkey wheat and any one that has good seed of that variety has one of the very best wheats and will do well to keep it until he is sure he has something better. (July 1901.)

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PASTURING WHEAT

While it is not possible to accurately forecast the outcome of the wheat crop, reasonable prudence would suggest that for the present, wheat should not be pastured to any great extent. The conditions have been such during the summer and fall just past that much wheat was sown in soil that had been poorly prepared, and even with the best of preparation, there has not been sufficient moisture for vigorous growth. There were heavy rains during the fall of 1900 and the soil was filled with moisture and thoroughly saturated. With these conditions and favorable winter weather, wheat furnished an unusua amount of pasture last winter and was in some cases actually benefitted by pasturing. The conditions are entirely different at present. In general, the fall rains have been sufficient only to moisten the soil to a depth of about six inches while the subsoil has scarcely been reached by the water. The wheat is thus dependent upon the rains that come during the winter and while it is possible that there may be plenty of rain for the purpose, the average rainfall of past seasons has been insufficient. It is true that feed is scarce and high in price and the wheat pasture sells for good prices. Some prefer to take what is to be had in the way of pasture from the wheat crop and to plant some other crop if the wheat is harmed by pasturing, fearing that possibly wheat may not yield well next harvest even if not pastured. Looked at in this light, pasturing wheat is profitable, even though it kills the wheat. But it will not do to follow the practice of last winter when it was scarcely possible to pasture wheat too heavily in Oklahoma.
(December, 1901.)

SELECTION OF COTTONSEED.

At ginning time in Oklahoma last year, cottonseed brought good prices at the oil mills and the greater part of it was marketed at that time. The result was a heavy demand for seed and a short supply last spring. There was seed enough, however, of one sort and another to plant a large acreage, and the tendency will be to sell seed close again this fall.

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Many questions are asked about varieties. The best answer to all of them is the remark of a southern cotton grower who said. "I can take any of the so-called distinct varieties of cotton and in a few years develop all the known varieties from it. In other words, they will develop themselves in the course of time. All that is necessary is to watch the field from year to year, and when a 'sport' is noticed save the seeds and plant them by themselves."

There is abundant evidence of the fact that cotton varieties become modified and become adapted to the conditions under which they are grown. There is thus every reason to believe that proper selection will develop a type or types of cotton particulary adapted to Oklahoma. In fact, it is probable that this type already exists on the few farms where intelligent selection of cottonseed is practiced.

There are three general ways by which new varieties are originated and by which the excellence of any variety is perpetuated. These are(1) saving seed from early maturing bolls, (2) selecting seed from plants of individual excellence, and (3) cross fertilization.

The first of these methods may be carried out without difficulty on every Oklahoma farm where cotton is grown. The first few loads of seed cotton are usually picked by the farmer himself, and he is thus enabled to know to a great extent the character of the lint. If these first pickings are ginned and the seed saved and taken home as seed for next year's crop, a long step has been taken toward the fixing of any desirable characteristics that the particular variety or mixture of varieties may possess.

The selection of seed from plants of individual excellence requires more care, patience and labor than the plan just described. It is not probable, neither is it necessary, that many cotton growers will go to the trouble and expense of carrying out this plan, yet there are substantial returns in store for a few who will do the work well.

Still fewer will attempt cross fertilization and there is less need of it. The improvement of the grade of our cotton can be steadily pushed forward by every cotton grower exercising care in seed selection from the present stock and when this comes to be the general practice, a sufficient number of specialists will appear to more than supply the demand for new varieties. (September, 1901)

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BROOM CORN.

Broom corn is a variety of sorghum and has many of the qualities of ordinary sorghum. Like sorghum in being hardy, it is a great drouth-resister and thrives under reasonably unfavorable conditions.

It can be planted at any time from the opening of spring until as late as July 1st with fair assurance of a crop. But as early harvesting and early marketing are especially desirable, it is usually advisable to plant it as early as Indian corn is planted, or from April 1st to 15th. If planted by the middle of April it will be ready to harvest by about the first of July. There is usually a lull in farm work about this time that makes it convenient for broom corn harvest.

There are numerous methods of planting it. It is planted in rows, checked and drilled. Drilling in rows gives the best results. The rows should be about 3½ feet apart and the stalks about 6 to 8 inches apart in the rows on ordinary upland and a little thicker on bottom land. If it is planted too thin on good soil, the heads become so heavy that their own weight bends many of them down, forming the "crooks." This crooked brush is heavy but because it is more difficult to make into brooms and makes a larger bulk in shipping, it brings about half-price on the market.

Owing to its being a hardy plant, the cultivation of broom corn is often sadly neglected. It will make a fair showing on poor land with very little cultivation, but it responds to good treatment and should be cultivated as often and as thoroughly as Indian corn. After the first heads appear it is not long before it is ready for harvesting, and everything should be in readiness, because it soon depreciates in value after it is once ripe enough to cut. In order to make the best brush it should be cut when the seeds are in the dough stage. A small patch for seed can be left until fully mature.

The standard varietes are harvested by breaking two rows together in such a manner as to form a table upon which the heads after being cut off are laid to cure. It should remain in the field about a day. A light rain or a heavy dew injures the brush.

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It is well if possible to cure it entirely in a shed. But if put in while green it must be placed in thin layers, which require considerable extra shed room. If left in the field, however, about a day after cutting, until it is nearly cured, it can be piled in good sized layers under cover, and seeded when convenient. The seeding is done by holding the brush on a cylinder similar to a thrashing machine cylinder. After it has been seeded, it should be bulked down in good sized piles and allowed to dry until the stems break quite readily. Then it is ready to bale. Both the seeder and a baler for a small farmer can be made by any carpenter at a small cost.

The yield varies of course with the soil and locality, but a good average yield is a ton of thrashed brush from 3 to 5 acres. An experienced hand can cut about one acre a day. The thrashing and baling costs about $4.00 per ton. The price varies so much that the profits for one year can seldom be assumed as a standard. Ordinary brush one year with another averages about $60 to $70 per ton.

It is a good crop on the sod. It shades the ground and helps to rot the sod besides making as good a growth as Kafir or sorghum without cultivation.

The seed and the stalks are utilized for feed, but their feeding value is low and it would hardly pay to raise it for feed alone, although in the western part of Oklahoma dwarf broom corn is sometimes sown for roughness instead of sorghum because it does not sour in the stack so badly. After the brush is harvested the stalks can be used for forage and then plowed under making an excellent green manure.

There are many varieties of broom corn, but "Mammoth Dwarf", and of the standard varieties "Improved Evergreen", and "California Golden", have proven to be very satisfactory in Oklahoma. Seed can be secured from local raisers or from western seedsmen.

Broom corn is a "cash crop" and like other cash crops has favorable and unfavorable features. Its cultivation on a very large scale is seldom successful, but if properly handled on a small scale, say from 15 to 25 acres for the average farmer and especially on new land where the variety of sure crops is limited, it will prove

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to be as paying as almost any crop that can be raised. Oklahoma has early seasons and can market the brush early in the season, when the highest price is usually paid, and for that and other reasons should easily become a great source of the nation's supply of broom corn. (December, 1901.)

BERMUDA GRASS.

Heavy grazing of the native grass pastures in Oklahoma has weakened them so they are no longer sufficient to carry the farm stock through the summer. Many farmers have broken out more land than they find it profitable to plant to annual crops and are seeking some grass that will furnish pasture through the summer. The experiment station and many farmers throughout the territory have tried all sorts of grasses and of the entire list, none seem to be equal to Bermuda grass for pasture. This grass resembles buffalo grass except that the stems and the leaves are larger and the growth much heavier. When once well established, Bermuda grass is green and growing from spring until heavy frosts come.

To start Bermuda grass on a worn-out pasture, disc the sod in late April or May, then scatter short pieces of the roots of Bermuda grass over the surface and disc again. The discing in itself will be of benefit to the native grassess and by this plan, Bermuda grass may be started and will quickly spread.

To start Bermuda grass on land that has been in cultivation, disc or harrow in April or May, run furrows two to three feet apart using a single shovel plow, drop pieces of roots by hand about a food apart in the rows, and cover with a double shovel plow or by harrowing. If weeds get ahead of the Bermuda grass, cultivate a few times. When the grass is once started, it will take care of the weeds.

Seed or sod of Bermuda grass may be obtained from southern seedsmen. A good plan is to prepare a piece of good land, from one-eighth to a quarter of an acre and sow one pound of the seed costing about one dollar. If weeds are kept out of this patch during the first season, it will furnish a supply of roots with which to start the grass in pastures.

Bermuda grass when once started is hard to eradicate. In

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the northern part of Oklahoma, it is sometimes winter-killed, but seventeen degress below zero was withstood at Stillwater without serious harm. Of course, the better the soil, the better the grass will grow, but it is not particular and will start and grow almost anywhere. It is particularly valuable for stopping washing of the soil in ditches and along embankments and at least merits a trial at the hands of every Oklahoma farmer. (February, 1902.)

RAPE FOR EARLY SPRING FEED.

Each season's results at the experiment station give further evidence of the value of the rape plant as a source of green feed in this country. Not only has it proven a most desirable spring and fall pasture crop, but a crop that will furnish a large quantity of green feed during such a drouthy summer as that of 1901. The plant lived through the mild winter of 1900-'01 but the zero weather of the past winter killed all the plants.

The rape plant will be one of the first plants available for feed in the spring and a large area should be put out, as feed is scarce and high priced.

The value of the plant lies in the fact that it will furnish a large amount of green feed in a short period from the time of planting. The plant resembles the cabbage in texture and color but the growth is erect and two to three feet tall. Good rich soil is necessary for a large growth and should be put in fine tilth before seeding.

The plant is proof against frost and may be seeded the last of February or early March in Oklahoma.

Broadcasting will do for temporary patches but if the crop is wanted to last through the summer it should be in drills and cultivated. Do not pasture too close if continuous growth is desired. For broadcasting use three or four pounds per acre. In drills one to one and one-half pounds will be required.

Twenty-three tons of green feed per acre have been taken off at the first cutting at this station. (February, 1902.)

ALFALFA IN OKLAHOMA.

The farmer who knows the true value of alfalfa and has the ability to raise it has a great advantage over his fellows who do not.

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The time is not far distant when the greatest factor in determining the value of a farm will be its adaptability for growing alfalfa. Under no conditions nor with any combination of feeds, where alfalfa is not included, can the animal products of the farm be produced at the minimum cost, be they beef, pork, wool, mutton, or dairy products. The alfalfa crop of the past summer sold as hay in the winter market at a cash value of $30 to $40 per acre. Where properly utilized, it has returned a greater value than the above when fed on the farm. For instance, a daily feed of 15 pounds per head with grain to fattening steers has saved one-fourth to one-third of the 60 cent corn, and where fed to young, growing stock, the showing is still more favorable.

Alfalfa as a soil improver stands at the head of the list. Due to its extraordinarily deep growing roots, it obtains its mineral food below where most plants feed. Like other legumes, it takes free nitrogen from the air by the aid of little organisms attached to the roots. Because of these two facts, alfalfa may be grown many years on the same land with the surface soil becoming richer all the time.

In some localities in Oklahoma, the acreage of alfalfa is considerable and the crop flourishes, while in other localities, failure seems to be the rule and of many acres seeded, very few remain now. Undoubtedly many of these failures have been due to very poorly adapted soil, but the majority of them are due to poor methods of preparing the seed bed, disregarding conditions at the time of seeding, and improper care of the crop after it has been started. A failure may be caused by any one of these or by a combination of them. It is a safe statement that where one acre of alfalfa is now grown in Oklahoma, one hundred might be grown.

Although the plant thrives on a large range of soils, the soil is an important factor in determining the success and productivity of the crop and on certain restricted areas, failure is certain. These are on soils where the rock is near the surface or that hold water to the degree of saturation for several days at a time. Where a stiff impervious clay comes within a foot or two of the surface, the growth of the plant will be weak and will be run out by crab grass unless very carefully nursed, and in unfavorable times this may fail to save it. On such soils the yield will be small. In the valleys of creeks

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and rivers where the soil is deep and rich and well-drained, alfalfa reaches its maximum but it can be grown on soils not nearly so favorable and very profitable results may be obtained.

The beginner should select his very best piece of land for a start, so as to make success as sure as possible for if he once learns the value of alfalfa, he will make it succeed on almost any soil. But most of the failures of alfalfa in Oklahoma are due to poor methods of starting the crop and improper care after it has been established. Crab grass is a great pest to alfalfa as well as to other crops in this country. The writer has seen new seeding of alfalfa get a start of eight or ten inches with a perfect stand and the crab grass catch it and smother it out before fall, and this when the mower was used. The point is that it is folly to seed a field of alfalfa without subduing the crab grass. On the stiff, heavy clays, the alfalfa will make a weak growth and the crab grass will flourish to perfection generally taking the field if stern measures are not employed to check it. On this foul land, preparation of the field for seeding alfalfa should commence a year or two previous to the time of seeding. One year in a crop that can be thoroughly cultivated throughout the season to keep any crab grass from going to seed is a good starter. Follow this with a crop next spring like oats that can be removed early. Plow deep and thoroughly as soon as the crop is removed and keep soil in fine tilth by frequent harrowings every week or two as the weeds start, or after each rain to break the crust. The ground wants to be well settled with a well pulverized surface. Alfalfa seeding on newly plowed ground is a failure as a rule because the ground is too loose and open.

The time of seeding alfalfa permits of considerable variation, both spring and fall giving good success when other conditions are given due consideration. Fall seeding has a better chance to get started ahead of the crab grass. Seedings from the middle of September to the last of October have given good results in this country. Spring seedings should not be made until the ground is warmed up and the danger of cold rains is past; about the last of March as a rule in Oklahoma. Late spring seeding will be bothered more with crab grass. But the condition of the seed bed must be suitable before seeding is made at any time. There must be moisture enough to

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start the seed at once, if not, wait; wait if it is six or twelve months. If the soil has been in fine tilth as long a wait as this will seldom be necessary.

Twenty pounds of good seed per acre should be put in. This may be broadcasted but drilling is a surer and more satisfactory method. A common grain drill may be used. It may be necessary to mix the seed with some material such as fine corn meal to get the drill to sow the proper amount.

The first year is a critical one with alfalfa and the weeds and grass should be kept down by frequent mowings made at the proper times. No stock should be pastured on alfalfa during the first and second years. The statement is often made that when alfalfa is once established, it will take care of itself. This is not true on many Oklahoma soils. The crab grass will gradually work in and the alfalfa will go out if something is not done to check the grass. This will be the usual result if alfalfa is pastured. The only way that the crab grass can be checked is by disking several times during the crab grass season just after the alfalfa has been cut. The disk must be set deep to have good effect. Harrow down thoroughly after disking. A disking in July and one in August will be necessary to keep the crab grass down.

Alfalfa should be cut after the plants make a good start to bloom, wilting only should be allowed in the swath. The curing should be done in small piles and the hay put in the stack before it is fully dry so as not to lose the leaves. (February, 1902.)

FEEDING WHEAT.

Feeding wheat to farm animals is not a novelty to the farmers who passed through the years of '93, '94 and '95 in this country, as many thousand bushels were fed during that time. Due to a very severe drouth which has caused almost a total failure of corn the farmer now has the choice of feeding wheat; of which he fortunately has plenty; or letting his stock go without grain. At 57 cents per bushel, wheat is by far the cheapest grain within his reach, and if the price of fat stock is mantained it can be fed with profit if the proper methods are followed. The feeder has the advantage of the experiences gained from '93 and '94 and any one not familiar with them should get them as they have been widely published in reports and papers.

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The value of wheat for hog food has been demonstrated by practical feeders and the experiment stations. Pound for pound it is equal or slightly superior to corn when properly fed. A bushel of wheat will produce from 12 to 15 pounds of pork when fed to thrifty shoats. Grinding at five cents per bushel pays well since when fed whole and dry about one-fourth passes through the hog undigested. Soaking does not lessen this materially, although the results are some better. Feeding sheaf wheat to fattening hogs has not proven economical but with pigs and stock hogs on a light grain feed it is practiced with good results.

Little definite information is on record in feeding wheat to cattle although hundreds have been so fed with good results. In the few experiments at experiment stations in this line, wheat has been fed mixed with other grain. When fed this way it has given results fully equal to corn. At the Ohio station steers fed on a mixture of wheat meal and bran required 6.7 pounds of grain to produce a pound of gain. At the Kansas station twelve steers fed on wheat meal for 63 days required 5.72 pounds of grain for each pound of gain. This is 10.5 pounds of beef from a bushel of wheat. The 63 days were the first part of feeding period. When the grain fed was limited in amount the steers ate it well without getting off feed. A thousand pound steer should not be fed over 16 to 18 pounds of wheat meal per day as wheat will surfeit a steer more readily than corn meal. Ground is the only condition in which to feed wheat to cattle and better results will be obtained with this if it can be mixed with bran or cotton seed meal.

Wheat meal makes good feed for dairy cattle but should be fed with alfalfa, bran, cotton seed or cottonseed meal, for the best results.

With sheep, wheat feeding has been very successful as the grain gives the best results when fed whole and dry, and the cost of preparation is saved. At the Michigan experiment station wheat fed to lambs returned 100 pounds gain for each 553 pounds of grain fed.

Opinions differ much on the merits of wheat as a horse feed. Due to improper methods of feeding, many poor results have followed but this does not detract from its worth for this purpose. Whole dry wheat cannot be fed to horses with good results, especially to work or driving horses. Soaking it improves some but grinding is by far the best method of preparing it for horses, but if it is fed as an exclusive

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feed, even in this condition, care will be neeessary to avoid colic at times. Much better results will be obtained by mixing half bran, oats, or corn with the wheat or mixing it with chopped feed.

The composition of wheat is such that for the animal to make the best use of it some food rich in protein must be added. Cottonseed meal can be used in most cases for this purpose. When corn or wheat is 25 to 30 cents per bushel this consideration has not much importance, but with the present prices the saving made by balancing up the ration will be considerable.

There will be considerable question as to how wheat will pay out this year when fed to fattening stock, but there can be no question but that it will pay to feed it to growing and breeding stock rather than to sacrifice them or let them suffer and deteriorate. (August 1901.)

STOCK FEEDING.

This is a winter of high prices for feeds, and it behooves every feeder to put much thought and skill into his operations that he may have the balance on the right side of the ledger at the close. Fat stock are bringing good prices and no doubt will the rest of the winter; and there is as much opportunity for profit in stock feeding in Oklahoma this winter as there has been any winter in the past. All that is necessary is to feed the right kind of feeds in the proper manner and combinations, to good stock.

The Oklahoma experiment station has published several bulletins on the value of different feeds and their proper combinations.

To compound the proper ration, (according to feeding standards) and the most economical ration, the feeder must take into consideration the market price of the feeds and the amount of digestible nutrients they contain and the character of the nutrients or compounds. Each nutrient in a feed performs more or less of a special office or work in the keeping up or building up of the animal body. For some purposes in the process of animal nutrition any of these compounds in the feeds will supply the want and do the work; but there are some functions in this process of building up of the animal body that require a certain one of these compounds or nutrients and no matter how much of the other compounds is present in the feeds they cannot take the place of this nutrient which is called protein. It goes to form blood,

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lean meat or muscles, hide, hair, milk, wool, and other like products that contain nitrogenous material in the animal body. As a rule for feeding purposes, the value of a feed depends largely upon the amount of protein it contains. For instance, every hundred pounds of corn contains 7.9 pounds of this nutrient, protein, that is digestible. Cottonseed meal contains in every 100 pounds, 37.2 pounds. When corn is worth 60 cents per bushel or $1.08 per hundred, cottonseed meal is worth about $40 per ton. This is when based on the amount of protein that the two contain, and to realize anything like these comparative values the feed must be fed in the proper combinations etc. For instance, for an exclusive feed for almost any kind of stock, corn is worth more per hundred than cotton seed meal. There is just as much loss of the nutrients in feeding when too much protein is feed, as when too little is feed. An example of the former case would be where nothing but cotton seed meal was fed and when nothing but corn was fed would be an example of the latter case. When feeds are very cheap these losses may not count for much but when feeds are high priced, as they are this winter, it is very important to see that the combinations of the feeds are such that they will furnish the different materials in the proper proportion to the animals, in order to make the waste as little as possible. The above comparitive prices put on corn and cotton seed meal might be said by some to be theory but numerous experiments at the experiment stations have demonstated that they have this approximate value when fed in the proper mixtures, amounts and manner.

The experiment station will figure out rations for those that cannot, if they will write and state what kind of feeds they have and the market price and the kind of animals they want to feed it to, and the approximate weight and age of animals.

The following table will aid in determining the best and cheapest feeds to use and combine.

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Market price and digestible nutrients per 100 lbs. of the following feeds.	Price per 100 lbs.	Protein, lbs. Digestible nutrients per 100 lbs.	Carbohydrates and Fat Equivalents	Total Digestible Nutrients
Wheat Straw	$ .15	.4	37.2	37.6
Cotton seed hulls	.15	.3	36.9	37.2
Alfalfa	.60	11.	42.3	53.3
Oat straw	.25	1.2	40.4	41.6
Prairie hay	.40	3.5	45.	48.5
Corn stover	.30	1.7	34.	35.7
Cotton seed meal	1.25	37.2	44.4	81.6
Cotton seed	.70	12.5	68.9	81.4
Oats	1.25	9.2	56 8	66.
Bran	1.15	12.2	45.3	57.5
Wheat	1.00	10.2	73.	83.2
Kafir corn, whole	1.08	4.7	32.6	37.3
Kafir meal	1.12	5.8	56.5	62 3
Corn	1.08	7.9	76.4	84.3

Bear in mind that the total amount of digestible nutrients in a feed goes as much toward determining the value of a feed as the amount of protein it contains.

The above feeds must be in the normal condition to contain the given amount of digestible nutrients. For instance, if corn stover or prairie hay were cut at the wrong time or allowed to get wet or are otherwise handled improperly, they might not contain more than half of the amount given above.

The following is given as answers in part to the many inquiries received by the experiment station about feeding cotton seed and cotton seed meal.

Steers give the best returns when properly fed on cotton seed or cotton seed meal.

The following results were obtained at this station during the winter of 1899-1900. The results are for four lots of steers containing five steers in a lot, and for 35 days.

The daily gain per steer was 2.6, 3.2, 2.45, and 2.99 lbs. respectively.

Grain eaten per pound gain was 8.02, 6.54, 8.73, and 7.01 lbs.

The grain for the first and third figures was Kafir meal 18 parts, cotton seed 4 parts, cotton seed meal 2 parts. In the second and fourth, corn meal took the place of Kafir meal.

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To realize the value of this showing, the fact must be known that the 35 days were the last of a feeding period of 147 days, and that in the first 112 days of the period the steers had made good gains. Where cotton seed or cotton seed meal are mixed with corn, Kafir corn, or wheat, steers made most excellent gains and this is the most economical way to feed it. Roughly, from four to six pounds of the meal mixed with 16 to 18 pounds of ground corn, Kafir corn, or wheat will make a good daily ration for a 1000 pound steer if he has good roughage.

Near the oil mill it is quite a practice to feed no other grain but cotton seed meal mixed with the hulls in the proportion of one of the former to three or four of the latter. Experiment station trials go to show that much better gains can be made for the amount of grain consumed when corn chop or some other like feed is a part of the ration. Even at the present price of corn and wheat it will pay well to buy wheat or corn to mix with cotton seed meal for steers.

Steers can be partially fattened exclusively on cotton seed, but they will not eat enough of it per day (about 13 lbs.) to enable them to make the best gains.

The Texas experiment station considers 33⅓ pounds of cotton seed worth about as much as 28 pounds of corn for steers and dairy cows. This makes cotton seed quite valuable this year. Cattle want to be brought onto a feed containing cotton seed very gradually.

Cotton seed and cotton seed meal are most excellent feeds to feed with other grains for dairy cows. Not more than 3 or 4 pounds of the meal should be fed per day. When fed in small quantities, 3 or 4 pounds per day, cotton seed meal may be fed indefinitely to steers and cows without injury to them, but if fed in large quantities, they may go blind in about 90 days. At this station rough yearling steers have been fed the whole winter on a ration of 4 pounds cotton seed meal and 2 pounds of corn and what roughage they would eat, and with good results.

Some deaths have resulted from feeding cottonseed meal to calves, but others have had good results.

It is generally conceded that cotton seed or cotton seed meal should not be fed to swine as many of them so fed die after three or four weeks feeding on it.

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But before letting swine want for the proper ration, it is well to consider the proposition of feeding them some cotton seed meal. In the experience of the feeder with a large number of experiments, cotton seed meal mixed with corn or Kafir corn has given the best of gains, but there has been some loss from hogs dying. But we think that the risk of loss is so small with our method of feeding it that all hogs on the station farm will have cotton seed meal as a part of their ration this winter. The ration should consist of about 1-5 cotton seed meal and 4-5 corn, wheat or Kafir chop. This should not be undertaken unless the risk of losing a hog or two can be taken, and the proper methods are followed. (See Oklahoma Report for 1900-1901 page 162.) In our judgement, the feed and cost that will be saved will over balance any hogs that we may lose.

Horses have been fed cotton seed and cotton seed meal in small quantities mixed with other grains with the best of results. Such a mixture would be the superior to a single grain as corn and this winter would lessen the cost of feed very much.

In all feeding, stock should be put on a grain gradually, and changes must be made very gradually, and care must be taken not to feed to much. (October, 1901.)

WHEAT MEAL, BRAN, AND SHORTS.

The feeder is frequently in doubt as to which is the cheapest, wheat meal, bran, or shorts when purchasing feed for cattle and hogs. If wheat meal costs $20 per ton, is it cheaper than bran at $15 or shorts at $16 per ton? Other considerations aside from arithmetic enter into the answer to this sort of questions. In the first place, the material sold as bran varies from the hulls of wheat to a mixture of the entire refuse from flour manufacture known as 'millrun'. And material sold as shorts is often mixed with bran in varying amounts. As used here, bran means material produced as a by-product of milling from which shorts have been separated. It should be flakey, light and bulky, and of the color of the wheat hull. Shorts on the other hand, should be fine, grayish in color, and free from all except small particles of the wheat hull.

The value of a feed, as a rule, is estimated on the basis of the amount of protein, carbohydrates and fat, and the total nutrients which it contains. These words are too often meaningless and will

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be better understood if protein is thought of as that part of a feed that makes growth; 'muscle-makers' is sometimes used to explain this term. Carbohydrates and fat are the fat formers; they also serve to keep up the heat of the animal body. By total nutrients is meant the sum of the compounds or substances in a feed that contribute to the nutrition of animals. Another term, nutritive ratio, is used to designate the proportion between the protein and other compounds in a feed. It is obtained by dividing the number of pounds of protein in 100 lbs. of a feed into the number of pounds of carbohydrates and fat.

The following table shows the composition of wheat meal, bran, and shorts expressed in the above terms.

FEEDS	Pounds in 100 Pounds			Nutritive Ratio
	Protein	Carbohydrates and Fat	Total Nutrients	
Wheat meal	10 2	73.0	83.2	1:7.2
Wheat bran	12.2	45.3	57.5	1: 3.7
Wheat shorts	12.2	58.5	70.7	1:4.8

If the total amount of nutrients determined the value of a feed, it would be a simple matter to decide which is the cheapest. On the basis of total nutrients, if wheat meal costs $20 per ton, wheat bran should cost $13.80 per ton and shorts $16.87. But the requirements of the animal to which the feed is to be fed must also be considered. The nutritive ratio of the ration fed to hogs and cattle may vary within reasonably wide limits. As a rule however, the grain ration should have a nutritive ratio from 1:5 to 1:6.5. The feeder who keeps within these limits, while he may depart from theoretical standards, will do better than if he feeds without system and without figuring.

It will be seen from the table that wheat varies on one side of the standard, and bran and shorts vary on the other. Thus it appears that a mixture of wheat meal with either bran or shorts would be cheaper than any one of them alone; even though the cost be greater.

For example, if wheat meal costs $20 per ton and shorts $16 per ton, a mixture of equal parts of each will cost $18 per ton. This

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mixture would contain in each 100 lbs. 11.2 lbs. protein, and 65.7 carbohydrates and fat making 76.9 lbs. total nutrients, and would have a nutritive ratio of 1:5.9 which would be better to feed than either wheat meal or shorts alone. When wheat meal is fed alone, there is an excess of carbohydrates and fat. In shorts there is an excess of protein. In the mixture, these are balanced, giving what is called a balanced ration.

Each set of conditions requires different management and in this season of high-priced feeds, the feeder must use pencil and paper wisely if he is to come out on the right side. The Experiment Station will calculate rations for Oklahoma feeders who desire it. The letter of inquiry should state the prices of different feeds, the character of roughness on hand, and the kind, age, and weight of the animals in order that the most economical ration may be suggested. The above remarks concerning wheat meal, bran, and shorts show how difficult it is to arrive at an exact decision when comparing the cost of feeds and how necessary it is to study feeds and their composition in order to feed to best advantage. (November, 1901.)

RATIONS FOR FATTENING STEERS.

The following combinations of feeds will be used in the steer feeding experiments at the Oklahoma Experiment Station the coming winter. The amounts in each ration are computed per day for a steer weighing one thousand pounds.

Ration 1.—Cottonseed 12 lbs.; cotton-seed meal, 3 lbs.; wheat straw, 10 lbs.; praire hay, 4 lbs.; cost 15¾ cents.

Ration 2.—Wheat chop, 11½ lbs.; cottonseed meal, 3½ lbs.; wheat straw, 10 lbs.; prairie hay, 4 lbs. cost, 20 3-5 cents.

Ration 3.—Cottonseed, 12 lbs.; wheat chop, 5 lbs.; wheat straw, 10 lbs.; prairie hay, 4 lbs.; cost 17¾ cents.

Ration 4.—Cottonseed meal, 10 lbs.; wheat straw, 20 lbs. (one half of this to be cut and mixed with the meal); cost, 17 cents.

Ration 5.—Cottonseed, 13 lbs.; wheat straw, 10 lbs., prairie hay, 4 lbs.; cost, 12¾ cents.

The following table gives the amount of food nutrients that the different rations contain and the amount required according to recognized feeding standards for a steer weighing 1000 pounds.

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	Pounds per day for a 1000 lb. steer.					
	Dry Matter	Protein	Carbohydrates	Fat	Nutritive Ratio	Cost Cents
Standard						
1st period	30.0	2.5	15.0	0.5	1:6.5	
2nd period	30.0	3.0	14.5	0.7	1:5.4	
Ration No. 1	26.0	2.79	9.41	2 53	1:5 8	15¾
Ration No. 2	26.0	2.65	13.85	0.70	1:5:8	20 3-5
Ration No. 3	28.0	2.19	12.34	2.24	1:8.0	17¾
Ration No. 4	27.0	3.8	8.95	1.30	1:3.2	17
Ration No. 5	24.0	1.8	9.2	2.34	1:8.2	12¾

The figures given as standard are the amounts of nutrients that were found by German experiments to give the best results with the least waste when fed to fattening steers. The amount of feed must be increased or diminished as the steer weighs more or less than 1000 pounds. These figures are not given to be followed absolutely but to be used as guides to be followed as the prices of the different feeds will permit, but better gains will be obtained as the ration fed approximates the amount of nutrients given in the standard. The division of the standard ration into first and second periods is not given close attention. It may be taken to mean that for the first month or two, such feeds as cottonseed meal are not necessary in as large quantities as in the next two months of feeding period. For example, in rations one and two, one-half to three-quarters of a pound of cottonseed meal might be left out for a month or two.

Comparing the rations that are planned to be fed with the prescribed standard, it will be seen that rations one and two are very similar and do not differ widely from the standard except in one point, with ration one. In this ration, the fats and oils are about five times the prescribed amount. The experiment will help to show just what effect this will have on the gains of the steers. The general experience is that it has very much of a loosening effect in the digestive tract, inducing scouring. Ration three is very good, but has the same fault as ration one, though not to the same degree. It is also slightly deficient in other points. Ration four varies quite widely from the standard, especially in the large amount of protein which it contains. Ration five does not approximate the standard in anything, but in some cases a similar ration has given paying results. Due to the low cost, this ration may be profitable, but it will hardly produce th

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rapid gains that some of the others will.

It is quite likely that the steers will not eat the amount of roughage given in the different rations. But it is very desirable that steers receiving meals, which are very heavy, concentrated feeds should have a certain amount of roughage. Each feeder should study carefully the feasibility of cutting part of the roughage and mixing it with the meal or of obtaining some other feed to mix with the meal to loosen it up and give it bulk.

It is not the plan to adhere strictly to the proportions of the feeds as given under the different rations if it is found advantageous to make slight changes, but no radical changes will be made unless it is found impossible to prepare the steers for market on a given ration. In the case of ration four, at least half of the straw will be run through the feed cutter and mixed with the cottonseed meal as fed. This plan may be carried out with the other rations during part of the feeding period to see if there is any advantage in it. During the balance of the time, the roughage will be fed in a separate rack. The amount of cottonseed to be fed was put at twelve to thirteen pounds, since it is said that steers will not do well when fed more than this.

The following market values per ton were taken in calculating the cost of the different rations; Cottonseed, $14; cottonseed meal, $25.; wheat chop, $23.; prairie hay, $8.; wheat straw, $4. These will vary in cost in different localities and on different farms, and in some cases, cheaper feeds could be substituted for them to good advantage.

The experiments will be carried on with twenty-five, two year old Shorthorn steers raised in this locality. The feed will be weighed in twice a day and the waste weighed out, and the steers will be weighed once a week. It is planned to feed the steers from 120 to to 130 days. In this time, gains of 250 to 350 lbs per steer are expected, depending upon the ration fed. Steers of this class have sold at from three to three and one-fourth cents per pound in this locality this fall. Unless there is an unexpected drop in the fat cattle market, these steers when fat should bring at least from five to five and one-fourth cents per pound in Kansas City. As the steers gain in

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weight, the ration must be increased so that the cost per day will exceed that given in the table. Taking everything into consideration, there is as much room for a profit in these steers as in an average year. (November, 1901.)

FEEDING COTTONSEED PRODUCTS TO STEERS.

The steer feeding experiments during the winter of 1901-1902 at the Oklahoma Experiment station were closed March 11 after a feeding period of 105 days, Twenty-five grade Shorthorn steers that were raised in the vicinity of Stillwater were divided into five lots of five steers each and fed the following rations.

Lot 1.—For the first seventy days. cottonseed, 12 parts; and cottonseed meal, 3 parts; for the last thirty-five days, cottonseed, 8 parts; and cottonseed meal, 7 parts.

Lot 2.—For 105 days, cottonseed meal, 3½ parts; and wheat chop, 11½ parts.

Lot 3.—For the first seventy days, cottonseed, 12 parts; and wheat chop, 5 parts: for the last thirty-five days, cottonseed, 8 parts; and wheat chop, 9 parts.

(Lots 1, 2, and 3 received the same kinds of roughage; four pounds of prairie hay per day per steer and all the wheat straw they would eat.)

Lot 4.—For 105 days, all the cottonseed meal and wheat straw they would eat. Twenty pounds of wheat straw per day was chaffed and mixed with the cottonseed meal as fed to the lot. The balance of the wheat straw was fed in a rack.

Lot 5.—For the first seventy days, four pounds of prairie hay per day per head and all the cottonseed and wheat straw they would eat; for the last thirty-five days, all the cottonseed, wheat straw and alfalfa hay they would eat.

The steers were three-year-olds in the spring of 1902 and of fair quality for natives. At the beginning of the experiment, Nov. 26, they averaged practically 1000 pounds, and were in fair flesh for steers off from grass.

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The following figures are for the feeding period of 105 days:

	Total gain lbs	Av. daily gain per steer.	Grain eaten lbs.	Grain eaten per lb. of gain.	Roughage eaten lbs.
Lot 1.....	928	1.79	6760	7.27	4664
Lot 2.....	1374	2.66	7744	5.63	6282
Lot 3.....	1088	2.07	7451	6.85	4089
Lot 4.....	912	1.73	5767	6.32	5280
Lot 5.....	659	1.26	4215	6.38	6734

The steers were sold on the Kansas City market March 17 in lots of five as they were fed. The selling prices and weights are given below.

	Total weight	Average	Price per 100 lbs	Dressed out per cent
Lot 1.....	5910	1182	5.20	53.2
Lot 2.....	6100	1220	5.60	57.6
Lot 3.....	6000	1200	5.40	56.1
Lot 4.....	5820	1164	5.25	56.3
Lot 5.....	5630	1126	5.00	55.3

The Ruddy Packing Co. made a careful slaughter test and the per cent dressed out is given above. The meat was not criticised in any respect, except that some of it lacked finish as might have been expected.

The change in the rations of three of the lots was found necessary as they were not doing well on the rations on which they were started. After seventy days feeding a change was made in the grain ration of Lots 1 and 3 for the reason that the steers would not eat enough of the former ration to enable them to make fair gains. The amount of cottonseed was evidently too much and that a reduction in the amount was desirable is plainly shown in the table which follows. Lot 5 refused to eat enough cottonseed and wheat straw along with four pounds of prairie hay per day per steer to produce anything like good gains. The introduction of the alfalfa hay that was eaten at the rate of about twenty pounds per day per steer during the last three weeks of the experiment, made a radical change for the better, as is shown in the table which follows. The periods were of thirty-five days each and it was at the end of the second period that the change in feed was made. The rations for Lots 2 and 4 were not changed.

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	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Lbs. gain 1st period	375	617	400	429	196
" " 2d "	190	379	250	227	121
" " 3d "	367	378	437	256	341

The steers were all perfectly healthy during the experiment and in so far as could be seen, could have been continued on the same feeds for some weeks and some of them at a profit. All of the lots would be classed as short fed cattle but Lots 2 and 3 were amply fattened for the prevailing market and were fairly well finished for cattle of their quality. Lots 1, 4, and 5 were only well warmed up, measured by the standard of well finished cattle, and they appeared rough.

Each lot of steers was followed by two shoats during the experiment and these lived and thrived. They were compelled to work over the droppings of the steers, as they were given about a half grain ration in addition to what they obtained from the manure. In order to study the results, no extra grain was fed at times and at other intervals it was very small. The average gain per shoat in Lot 1, was 92 lbs.; in Lot 2, 76 lbs.; in Lot 3, 130 lbs.; in Lot 4, 82 lbs.; and in Lot 5, 133 lbs. The total wheat chop fed during the whole feeding period averaged 337 lbs. per shoat. The pigs averaged 103 lbs. at the begining of the experiment.

Taking feeding steers at $3 25 per 100 lbs., cottonseed at $16, cottonseed meal at $25, wheat chop at $25, wheat straw at $5, prairie hay at $10, and alfalfa hay at $12 per ton, and the fat steers at the prices sold in Kansas City, and not taking into account the labor or the manure, the lots made the following net returns; Lot 1, $43.19; Lot 2, $43.79; Lot 3, $52.18; Lot 4, $41.06; Lot 5, $33.30.

The fact that the shoats following the steers fed no grain except cottonseed meal lived is a point that should be noticed. Reports from feeders vary on this point. In some cases, pigs are said to die when following such steers and in other cases they do not. It probably depends on whether the steers get cottonseed meal and no other grain and whether the pigs get any other grain than that which they get in the droppings. As a rule, steers fed exclusively on cottonseed meal

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are not followed by hogs, but when only part of the ration is cottonseed meal, many feeders run hogs after them with but little loss from death. It is probably safer and more economical to feed the pigs a little extra grain.

These experiments seem to indicate that if cottonseed is to be used in fattening steers, the amount fed should be limited to four to six pounds per day and preferably mixed with other grains. If it is to be the exclusive grain in the ration, the roughage fed with it must be highly palatable and nutritious. Even then, it is more suitable for cattle that are roughing through than for those with which rapid gains are desired. As an exclusive grain, it did not scour the cattle or make them sick in any way, but it was not palatable enough to induce them to eat the desired amount. (April, 1902.)

FEEDING COTTONSEED MEAL TO HOGS.

The Oklahoma experiment station has issued a bulletin reporting the results of an experiment in feeding cottonseed meal to hogs. The following brief statements comprise the chief results given in the bulletin:

1. Of a lot of four weanling pigs fed a grain ration consisting of one-fifth cottonseed meal and four-fifths corn meal, and kept in a small pen, two died after being fed this mixture for forty days. The other two lived and thrived and were fattened on the above mixture without change in 126 days. During that time they made an average daily gain per pig of 1.07 pounds, and for each pound of gain they ate 3.37 pounds of grain and that had a value of 2.24 cents.

2. Of a second lot of 4 weanling pigs kept in a small pen and fed a grain ration of one-fifth cottonseed meal and four-fifths corn meal for four weeks, then corn meal for two weeks, alternating in this manner during 18 weeks, one died at the end of five weeks, (after being fed for four weeks on the mixture and one week on pure corn meal), the other three lived and thrived and were fattened at the end of 126 days. During that time the average daily gain per pig was 1.06 pounds and for each pound of gain they ate 3.68 pounds of grain that had a value of 2.14 cents.

3. A third lot of 4 weanling pigs were kept in a small pen and fed a grain ration consisting of one-third corn meal and two-thirds

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wheat middlings, for 126 days and all were well fattened at the end of this time. The average daily gain per pig was 1.15 pounds, and for each pound of gain they ate 3.7 pounds of grain that had a value of 2.87 cents.

4. A fourth lot of four weanling pigs fed corn meal for 84 days and kept in a small pen, made very poor gains and a change of feed was necessary to fatten them. In the 84 days they made an average daily gain per pig of one-half pound, and for each pound of gain they ate 5.6 pounds of grain that at a value of 2.99 cents. When changed to a grain mixture of one-fifth cottonseed meal and four-fifths corn meal the gains were increased and in 42 days following the change, they made an average daily gain per pig of .92 of a pound, and for each pound of gain they ate 3.42 pounds of grain that had a value of 1.95 cents. For the total feeding period of 126 days the average daily gain per pig was .62 of a pound, and for each pound gain they ate 4.7 pounds of grain that cost 2.61 cents. At the close of this period only two of the pigs were in a marketable condition, but the others were making good gains.

5. In this experiment when weanling pigs were kept in small pens and fed a grain ration containing one-fifth cottonseed meal and four-fifths corn meal, one-fourth to one-half of the number died after being fed the ration five to seven weeks; those living and fed the above ration, continuously and alternatingly with corn meal, were fattened with most excellent results.

6. The amount of grain required to produce a pound of gain was practically the same with pigs getting cottonseed meal as it was with pigs getting middlings, but was much less than that required by pigs getting corn meal. The pigs getting one-fifth cottonseed meal and four-fifths corn meal alternating with corn meal, required 34.5 per cent, less grain to produce a pound of gain than did the pigs that were getting only corn meal.

7. More economical gains, disregarding losses caused by death, were obtained by feeding rations containing cottonseed meal than by feeding either corn meal or a mixture of corn meal and wheat middlings. With corn meal worth 53.5 cents per cwt., wheat middling, 90 cents, and cottonseed $1.00 per cwt., the gain of the pigs getting

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one-fifth cottonseed meal and four-fifths corn meal alternating with corn meal cost 23.5 per cent, less than the pigs getting two-thirds wheat middlings and one-third corn meal (84 days). The cost of the gain of the corn meal fed pigs was a trifle more than that of those getting middlings in their ration, but the outcome of the former should be considered a failure and unprofitable while the latter was a success and profitable. (January, 1902.)

A GOOD PEAR.

The Rutter pear has borne good crops in Payne County, Oklahoma, the last two years and seems perfectly hardy in every way. It is one of the best varieties for Oklahoma and should be one of the most popular pears in the country.

The tree is a moderate grower, an abundant and early bearer, with young wood of a dull-olive yellow brown color. Fruit, medium to large, nearly globular; skin rough, greenish yellow, sprinkled and netted with russet and numerous russet dots; stalk long, large and woody; flesh white, juicy, melting, sweet vinous flavor; ripe September and October. (October, 1901.)

A GOOD GRAPE.

The R. W. Munson is one of the best varieties of grapes that has fruited in the Experiment Station vineyard. During the past summer, it has shown its ability to withstand almost any drouth. It was the only one of about fifty varieties in the vineyard that was not badly damaged by the green leaf hopper or thrip. Its foliage remained free from these insects and retained its dark green color throughout the season.

Vine large, rapid grower; cluster medium to large, cylindrical, often shouldered; berries large, round, black, evenly ripened; skin thin, tough; pulp tender, juicy, sweet, very good flavor, ripe just before the Concord. (October, 1901.)

FRUIT TREES.

This is the season of the year when orders are being given for nursery stock for fall planting and those about to set out an orchard should avail themselves of the experience of those who have been en-

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gaged in fruit growing in Oklahoma.

In general it pays to buy home grown nursery stock and to disregard the blandishments of the man with something new and wonderful. The varieties mentioned below are reliable and preferred by many successful orchardists.

Apples:—Missouri Pippin, Ben Davis, Winesap, Jonathan, Maiden's Blush, Lowell, Cooper's Early White and Yellow Transparent.

Peaches:—Amsden, Alexander, Early Riser, Mountain Rose, Old Mixon Free, Elberta, and Heath Cling.

Plums:—Wild Goose, Weaver, Golden Beauty, Forest Garden, Pottawattomie, Abundance, and Burbank.

Pears:—Rutter, Kieffer, Duchess, Seckel, and Bartlett,

Cherries:—Early Richmond, English Morello, Montmorency.

Grapes:—Concord, Delaware, Goethe, Jaeger, Brilliant, Niagara, Herbemont.

Good nursery stock is of prime importance, but the character of the care which is given it after setting it out determines to a great extent the degree of success that will be attained. Continued clean cultivation and watchful care is necessary and will be abundantly repaid. (November, 1901.)

SPRAY APPLE TREES.

When the first apple trees began bearing in Oklahoma, there was hardly a worm of the codling moth to be found in the whole crop. There are no native plants here upon which this insect can live and it was slow to get started in the young orchard and it did almost no damage to the first three crops. This insect has meat almost no opposition and has increased very rapidly and this year has destroyed a large part of the apple crop all over Oklahoma. The dry weather has been a help to the worms in destroying the crop this year. Most of the bearing orchards set a fair crop of fruit last April but only a small part of this crop will be matured. The amount of windfall apples that has been placed upon the market this year is much larger than any previous year.

At the experiment station the windfall apples from three Missouri

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Pippin and three Stewart's Golden apple trees were examined and not an apple was found that did not contain a worm or the traces of a worm in the core. The land around these trees has been well cultivated and kept free from weeds and grass. The trees made a fair growth during the summer and have shown no signs of suffering from drouth. The trees were not sprayed or protected from the insects in any way. There is every reason to believe that the worms were the chief cause of the apples falling.

An examination of the apples on the market showed that almost every apple contained a worm or the burrow where one had been. Granting that these apples were from orchards that have not been well cultivated and suffered from drouth, the worms have greatly damaged the crop.

Three fourths of the apple crop can be protected by spraying with Paris green. The cost of the necessary apparatus and the labor of spraying are but small items of expense and are now necessary to the growing of a good crop. (September, 1901.)

CULTIVATE TREES.

Illustrations of the value of cultivation to trees can be seen on almost every farm in Oklahoma this summer. The trees that are standing on cultivated land have grown most of the summer and have stood the dry season very well, while those on uncultivated land have made but little growth and many have died. The value of cultivation has been greater this year than common but the aggregate results are about the same. The trees that are well cared for and well cultivated will make a good growth each year and be strong healthy trees, able to resist the attacks of insects and diseases.

On the experiment station farm there are two rows of soft maple trees that were set out at the same time and were of equal size and vigor when set. These trees were given the same care and cultivation for three years after they were set and made about the same growth. One row has been given almost no cultivation for the last four years while the other row has been well cultivated. The height of five trees in each row was measured September 11. The trees in the cultivated row averaged 22 feet and in the uncultivated row averaged 13 feet in height. Three of the trees in the uncultivated row had been sun-

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scalded on one side of the trunk and had peeled off. The other two trees died during the summer and the trunks were full of borers The cultivated row is in good condition and shows no signs of sunscald or borers. (September, 1901.)

FALL PLANTING OF TREES.

Young trees that are bought from the nursery should be planted in the fall. Over ninety-five per cent of the nursery trees are dug in the fall and exposed to the sun and wind all winter without sufficient moisture to keep the trees in perfect condition. These trees should be delivered in the fall and set out in the orchard before January. The sooner the trees are set in the orchard after being dug the better. The trees should be well planted and the moist soil pressed firmly about the roots. The top of the trees gives off moisture in the winter through the bark, and the roots must be well packed in moist soil to supply this moisture; a condition which seldom exists when the trees are in temporary quarters. If the trees are set in the fall, the soil settles around the roots in the winter and will be full of moisture and the trees are ready to start into full and rapid growth in the spring. November and December are usually the best months for transplanting trees and shrubs.

Trees set in the spring will usually grow and do well but the results are not so uniformly satisfactory. The trees are seldom in as good condition for spring setting as for fall. (October, 1901.)

PLANT TREES AND CARE FOR THEM.

Governor Ferguson of Oklahoma prefaced his arbor day proclamation with the following appreciation of the beauty and utility of trees:

"In all ages men have loved trees. The beauty of their foliage, their grateful shade in the heats of summer, and the protection of their encompassing branches from the blasts of winter, led primitive men to build their homes in the forests. Trees made it possible for men to pursue the trackless ways of the seas, and from their trunks, were carved the very sinews of civilization. Year after year, the blossoming of trees gladdens the hearts of men with the promise

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of renewed life. To plant trees is to assist nature in perpetuating one of her most priceless gifts to humanity."

Arbor day is fixed by legislative enactment and Friday, March 14, has been so designated in 1902: a time when trees may be planted with every promise of success.

Trees add much to the comfort, beauty, and value of the home, whether it be in the city or in the country. The value of shade trees about the house is appreciated almost every day from May until October, and no effort to increase the number of trees is wasted. A grove, if well cared for, increases the value and productivity of the farm. The greatest benefit is realized when the grove is placed so that it will form a wind-break on the south and west sides of the orchards and on the north side of the barns and feed lots. This location need not interfere with the grove's producing a constant supply of posts and fire-wood.

There are many trees that, if given proper attention, grow rapidly in Oklahoma. Some of these may be taken from the native forest andall may be obtained from nurseries at a reasonable price and in first-class condition for transplanting. Nursery-grown trees usually grow better when transplanted than those taken from the native forest. The small forest trees are usually sprouts from old stumps and cannot be taken out with a good root system for transplanting. Trees in a native timber are accustomed to shade and they suffer when exposed to the direct heat of the sun and to the wind.

The soil in which trees are to be planted should be given as thorough preparation as for any other crop. It should be plowed to a depth of at least eight inches and firmed down by repeated harrowings. Where trees are to be planted for shade the holes should be dug large and deep, three feet each way is not too large, and filled in with surface soil to the depth at which the trees are to be set. This work should be done as long as possible before the time for planting the trees, and if now, the soil that is filled into the holes should be saturated with water before setting the trees. Trees that do not have good roots should not be set where they will be exposed to the direct force of the wind. When transplanting, set the roots at about the same depth as that at which they grew naturally, and press the

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soil firmly about the roots. This is a very important point and frequently neglected.

Trees should be pruned when set. The broken and crushed roots should be cut back to sound wood; they usually are cut short enough in digging. The tops should be cut back so as to properly balance them with the roots; one year old trees may be cut back to the ground, two year old trees should have about half of last years growth removed, and older trees should be pruned quite severely. No set of rules can be followed in all cases and individual judgment must determine what is to be done with each tree.

In planting for a grove, the trees may be set three or four feet apart, in rows seven or eight feet apart each way, or in check rows four or five feet apart each way. The first method will admit of cultivation for a longer time than the second and thinning will not be necessary for a longer time. Trees one year old are suitable for grove planting and may be set in furrows plowed for the purpose after the soil has been put in good condition. In every case the trees should be set thicker than they are expected to stand when grown. It is easy to remove a tree.

Trees set in isolated positions are especially exposed to the hot sun and attacks of borers. In such places, the trunks of trees that are taken from the native forests should be protected during the summer by standing a board on the southwest side of the tree.

The trees most generally planted have been elm, soft maple, catalpa, black locust, and box elder. The elm grows slowly at first and is attacked by borers, but it is the best shade tree in the list and should be included in every planting for shade. The soft maple is easily broken by the wind and suffers from drouth and the attacks of borers, but it grows rapidly from the start and makes a pretty tree. The limbs of the catalpa are easily broken by the winds, but it grows rapidly, makes a fair shade, and is valuable timber for posts.

The black locust is not generally regarded as a first class shade tree and its tendency to sprout from the roots makes it somewhat objectionable on lawns. But it is the fastest grower in the list, will stand more neglect than the others, and the wood is very durable for posts. The box elder is a moderate grower and is not adapted to poor, upland soil, though it does well in favored locations. The ash,

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and sycamore are good trees, but are not adapted to as wide a range of soils as the others.

While the present season does not afford the best of conditions for planting trees, success may be had by all who make an earnest effort. The holes should be well watered when the trees are set and if there is a shortage of rainfall up to the time that growth starts more water should be supplied. After the growth has started and the soil is once filled with moisture, it is then a matter of cultivation. The soil at all times within at least three feet, and better ten feet, of the trees should be kept loose on top and free from grass and weeds. If there are fifty trees or less they should be hoed after every rain; it can be done in an hour. Where the trees are in rows, cultivation with horse tools is cheaper and as effective. Dirt should should not be piled up around the base of the trees so as to run water away from them. It is better to have a basin-shaped depression to catch the water that falls and let it soak in.

The planting of trees is commendable and cannot be too strongly urged upon any one who owns even ten square feet of land. But the planting is the least part of the operation. The daily, weekly, and monthly care which is given the tree during the first ten years after transplanting determines whether or not the tree will continue growing. None but those who love trees can succeed in growing them in Oklahoma but nowhere else is care and attention more abundantly repaid. (March, 1902.)

CULTIVATE THE TREES.

Many of the trees that were planted for shade and fruit this spring are already dead. Many more will die before the summer is past. The chief cause for this loss has been and will be neglect. Assuming that the trees have been planted properly and that they were of sorts adapted to Oklahoma conditions, at least ninty-five per cent of those planted should live and thrive. Orchardists as a rule give their trees every needed attention and lose but few trees. The most notable example of intermittent enthusiasm may be seen along the streets of towns and cities. When spring comes, nearly every one plants trees as a matter of course or to get rid of some tree agent. Too often when

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the planting is done, no further attention is given. After planting, the dirt is often piled up in a nice mound about the base of the trees possibly with the notion that this will hold the tree in place. The result is that what rain falls is drained away from the roots of the trees instead of toward them. Instead there should be a slight depression about the trees so as to get a little excess of water if possible and let it soak in. Cultivation throughout the summer should be given if trees are wanted. The growth of the trees will be better if all the space between them is cultivated after every rain. This is hardly desirable about the house and the next best thing is to cultivate a space about the trees. The soil should be hoed and kept loose for a space of from three to five feet about the trees, the larger the cultivated space, the better. It isn't a hard matter to grow trees if one will give them a little attention right along and will think of them as a crop that should be cultivated if good growth is expected. A treeless town is always cheerless to the stranger, while streets bordered with thrifty trees are attractive and are appreciated by all. Cultivate the trees every time it rains and sometimes between times. (May 1902.)

BLACKBERRIES IN OKLAHOMA.

The frequent failure of raspberry and strawberry plants to make a good growth and produce fruit increases the amount of importance attached to blackberries. This crop pays on almost all kinds of soil in Oklahoma. It does best on sandy loams and when well cultivated makes a very rank growth. The Early Harvest, Snyder and Kittatinny are all doing well at the experiment station. The Dallas, Lawton, and Minnewaska, are gaining favor in some localities. The dry season generally cuts the crop of late berries short.

The plants should be set two to four feet apart in rows six to eight feet apart. The plants should be kept in rows and all plants that come up in the cultivated space between the rows should be removed. If the plants are allowed to produce canes at will they will soon form dense matted rows which should not be more than one foot in width at the ground. This will make picking and cultivation easier and give better feeding ground to the plants that are to bear fruit.

The cultivation should begin in the early spring and continue

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through the summer. Shallow, level cultivation should be used to conserve the moisture. Deep cultivation will cause the plants to sprout in the spaces between the rows and in other ways injure the growth of plants in the rows. The weeds and grass must be kept down with the cultivator and hoe.

Mulching is a good practice on small home patches. The land should be well cultivated in the spring and then the mulch applied. The mulch may consist of old hay or straw that is free from seed, or coarse manure. It should be evenly scattered over the ground about four to six inches deep and remain there until time for cultivation the next spring. It can then be drawn into the rows and after the cultivation be spread over the ground again and more added if necessary. Mulching gives better results, both in growth of vine and production of crop, than the best of cultivation. On test plats fruited in 1901 the Early Harvest blackberry produced a half more fruit on the mulched plat than on the cultivated plat. The Snyder and Kittatinny each produced three times as much fruit on the mulched plats as on the cultivated plats. Judging from the present condition of the vines, the difference between the crops of the mulched and cultivated plats will be much greater this year than last.

Pruning has little or no effect upon fruit production, the pruned plats yielding about the same as those that were not pruned. However, if the vines make a rank growth it is a good plan to top them. This will cause the plants to branch more and be strong and stand better. The old vines should be removed as soon as dead. (May, 1902)

POTATO GROWING.

The experiment station has been investigating methods of growing and storing potatoes and has reported results in a recent belletin.

The methods followed by potato growers of Pottawatomie county, where large quantities are grown for market, are briefly described. The soil of this district is a sandy loam with a porous subsoil, making it an ideal potato soil. The soil is plowed in early winter and the planting done as soon as danger of hard frosts is past, usually from the middle of February to the first of March. Most of the planting is done with planters, dropping the seed from twelve to eighteen

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inches apart in rows about three feet apart.

Bliss Triumph is about the only variety planted and the seed used is either from the second crop of the previous season or is imported from the North. Cultivation is shallow and frequent and discontinued when the potatoes are about half an inch in diameter. Digging is done by machinery and the potatoes are sold at once. The crop is marketed in June and a second crop is planted, the culls from the first crop being used for seed. Good profits are realized and the industry is developing rapidly.

A table showing the results of variety tests made on the station farm during 1900 and 1901 is given in the bulletin. The results show great variations in yield between different varieties and in different seasons.

Trials of time of plowing for potatoes uniformly resulted in larger yields from fall than spring plowing. The best depths and the time of planting varies with the season and the condition of the soil. The planting should always be done as soon as the furrows are opened, since the drying of the soil in the furrow retards sprouting.

Of all methods of storing potatoes tried, it was found best to keep the crop in the field, by mulching with straw or hay in the spring or early summer after cultivation has ceased, and leaving the the potatoes in the ground until fall. If rain should cause them to sprout or decay, they should be dug and stored in small boxes or crates in a cave. If the patch is not mulched, the crop should be dug as soon as mature and stored in a cave. The potatoes should not be left in the sun, but should be taken to the shade as fast as they are dug.

This bulletin also contains a report of variety tests of cabbage during 1900 and 1901. (January, 1902.)

ANIMAL PARASITES.

The experiment station has for some time been collecting information in regard to the occurence and distribution of the most common parasites of the domestic animals. The amount of injury and loss caused by parasites and the readiness with which most of them may be exterminated makes it of some importance to the farmer and

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stockman to know something of the parasite and remedy.

This general method of asking for information is used in the belief that those interested will send in specimens of all forms of parasites they may find on any of the domestic animals. All specimens of external parasites such as lice, ticks, fleas etc. may be sent in small boxes or bottles. Where the scab mite of sheep or the itch mite of horses and cattle is suspected the dried crusts from the sores with the wool or hair from around the sore will give sufficient material from which to obtain the parasite. Any of the intestinal parasites such as round or tape worms may be sent in alcohol.

Recently specimens of the flea from chickens and turkeys were received at the station. Information concerning the occurence of this parasite will be appreciated as it is rarely found as far north as Oklahoma but under favorable conditions may do considerable damage among fowls. (October, 1901.)

VACCINATION TO PREVENT BLACKLEG.

Blackleg is the most common disease and at the same time the cause of the greatest amount of loss to farmers and stockmen of any cattle disease in the territory. Every one is so familiar with the disease that a description of the condition seen on the post mortem examination is unnecessary. Stockmen know that young cattle and especially fat calves, or those gaining rapidly in flesh are the ones most likely to take the disease and that they usually die in from twelve to thirty-six hours after the first symptoms are seen.

In many cases the farmer does not know the best means to be used in dealing with this disease but continues to use some of the popular remedies that do not cure and are worse than useless in preventing the disease. The user may have confidence in such remedies as roweling and nerving, when they give no protection to the animal in any degree. The cause of blackleg is a germ and any wounds made in the skin will increase the chances for infection.

It has been but a few years since it was necessary to try to convince every stockman against his will that the tick was the means of carrying Texas fever from southern cattle to northern cattle. At the present time very few disbelieve the "tick theory" and as a result there

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are fewer cases of fever every year and eventually the loss from this disease will amount to very little. At the present time vaccination to prevent blackleg is to a great many something new and they are slow to place confidence in a remedy for a disease that has always been so fatal. Vaccination has been extensively tried during the past few years and the results prove that it is a very effective means of preventing the disease. A great many inquiries are received asking for a cure for this disease but there is no remedy to offer as a cure. Prevention is the only safe course and vaccination is the only means that can be successfully used as a preventive. The process of vaccination is simple, the only instrument needed being a good heavy hypodermic syringe.

The experiment station is sending out vaccine free of any charge to farmers and stockmen of Oklahoma and Indian Territories. Considerable effort has been made to secure the general use of vaccine because the loss from blackleg is so great, probably more animals dying every year in Oklahoma from this disease than from all other cattle diseases combined. The disease is more prevalent during the spring and fall and for this reason the station desires at this time to acquaint those interested with the necessity for vaccination. The vaccine can be obtained from the experiment station by sending in a request stating the number of cattle to be vaccinated. (April, 1902.)

A further reference to the use of vaccine is made necessary on account of some complaints that have been made in regard to the effects of vaccination. Too great stress cannot be placed on the necessity of cleaning every article used in preparing the vaccine and especially the syringe. This should be thoroughly cleansed after using by placing it in hot water and then drying well before placing in the case.

The next step requiring special care is filtering the vaccine. Nothing but absorbent cotton should be used and every dose of the vaccine should be filtered through this. The fluid after coming through the cotton should be slightly clouded. Filtering is necessary to remove the coarser particles of the vaccine and it also prevents the injection of material that has no value as vaccine. Another important matter is the size of the dose and the handling of the cattle so as to prevent the possibility of vaccinating the same animal twice. A full dose may be given to cattle over six months old and younger animals should have

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less depending on the age and size. As the work is ordinarily done there is danger of vaccinating the animal twice, as the vaccinated animals are turned back into the lot with those not vaccinated. In this way it is very easy to make mistakes. If the work were done as carefully as it deserves to be done the results would be more satisfactory to all concerned. (May, 1902.)

LOCO INVESTIGATIONS.

The experiment station has under way some experiments and studies concerning the "loco weed". This well known weed is fairly well distributed over the western half of our territory and is a source of considerable loss to the stockmen of the region mentioned. Probably all cattlemen are familiar with the symptoms exhibited by the so called "locoed" cattle but as yet the exact nature of the poison contained in the loco has not been determined—the fact is that many doubt the existence of any specific poison in the loco plant. Investigations regarding this poisonous principle and the general nature of locoism are now being conducted by the veterinarian of the station and it is hoped this work will yield some positive results regarding this subject.

For some time stockmen have known that the loco plant was more common some years than others but no very definite reason has as yet been given for this phenomenon. It has been suggested that the loco weed during certain years is largely destroyed by insects that make their appearance during certain years in abundance. Some preliminary field work seemed to make this explanation quite reasonable and the botanist and entomologist of the station has commenced a thorough study of the insects known to infest the loco. Some interesting facts have already developed along this line but some time must elapse before the final announcement of the results of the work can be make.

The final object of the work is to offer the stockmen some relief from the great losses they are now suffering and the experiment station therefore desires to secure the hearty co-operation of all persons interested in the extermination of the loco weed from the ranges. It is especially desired that all persons interested in the subject send in

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full statements regarding the possible connection of the loco eating habit and rather the common occurrence of abortion among cattle. The losses from this source among stockmen are very great and many seem inclined to think that the abortion is caused by the eating of the loco plant. In fact it is not uncommon to have other evil effects connected with the eating of loco. All these questions will receive attention during the investigations.

It is particularly desired that specimens of the loco plant and all the insects found upon the plant be sent to the station for examination and study. These specimens may be sent by mail enclosed in a pasteboard box of proper size. Such assistance as that mentioned will do much to hasten on the work along this line now commenced. (August, 1901.)

WOOLY APHIS.

Upon the request of an agent for an Ohio nursery for which delivery of nursery stock was being made in Stillwater, the Entomologist of the Oklahoma agricultural experiment station made an examination for injurious insects. The Entomologist reported as follows: "Both roots and stems of this lot of trees are infested with an aphis which is, in all probability, the 'wooly apple louse'. The winged form of the insect, which is necessary to make identification complete, seems to be wanting."

This incident serves to emphasize the importance of caution in buying nursery stock. Where the presence of harmful insects is suspected, specimens should be sent to the Experiment station before receiving and payingforthe trees. (November, 1901.)

BORERS IN SOFT MAPLES.

The soft maple has been planted as much, or more than, any other tree in Oklahoma for shade, and in shelter belts, etc. It is usually accepted as a good tree. It is a fast growing tree, and in many instances has showed remarkable ability to live and grow during the dryest summers. It has, however, lost some of its prestige during the past summer. The trees die back to the ground very badly if transplanted in the fall. The weakness of the tree has caused

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many failures this year. If transplanted in the spring it is very hardy and grows readily, but fall setting followed by a dry season is seldom satisfactory.

The maple seems to be entirely outclassed when planted in close mixed planting with elm and black locust. A mixed grove on the experiment station farm gives a good comparison of these three trees. In the south ten rows of the grove there were one hundred and nineteen maple trees, one hundred and sixteen elms, and forty-seven black locust trees. Of this number, one hundred and two maples died during the summer of 1901; all of the elms and black locusts are still living. Seventy-five maple trees, all of which are dead, were attacked by the flat headed borers during the summer. Thirty-seven elms had been attacked by borers but not one locust showed a sign of borers. The drouth no doubt caused the death of most of the trees. The borers showed a great preference for the maple trees. All of the trees are five years old and were set in the spring of 1898. The maples and elms averaged about the same size, nine feet high, last spring and the black locusts about fifteen feet high. (January, 1902.)

PROTECTION AGAINST PLANT-DISEASES AND INSECTS.

Plant diseases and insects are doing so much damage to the orchards and gardens in Oklahoma that it has become necessary to protect the plants by some artificial means. The method of destroying the diseased and wormy fruit and foliage is of great value if persistently carried out. This cannot be done in so thorough a manner, however, as to destroy all the diseases and insects present, and a few left over and those that will come from neighboring farms will produce a dangerous number next year. The cheapest and most practical method of protecting plants from diseases and insects is spraying. The ideal method is to spray thoroughly and then destroy all diseased fruit, leaves, and trash about the orchard and garden. Either method is good when used alone and the value of each is greatly increased when used together.

Spraying solutions are divided into two general classes. Those designed to prevent the attacks of fungus diseases are called fungi-

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cides, and those designed to destroy or prevent the attacks of insects are called insecticides.

Fungicides protect the plants by preventing the fungus diseases from gaining a foothold on the plants. The solutions are composed of materials that destroy the germinating spores where it comes in contact with them. The copper and sulfur compounds are the most effective materials used in these solutions. Most of the fungus diseases of plants that can be prevented by spraying reproduce by means of two kinds of spores. One kind of spore is produced in the spring and summer and germinates soon after maturity. If the spore finds lodgment on tender growing parts of the plant and a favorable amount of heat and moisture is present germination and growth immediately follow. If these spores do not soon germinate they lose their vitality. This process of germination, growth and fruiting goes on during the spring and summer. Late in the season another kind of spore is produced, which is capable of passing through the winter and germinating the following spring. The germinating spores send the roots directly into the tissue of the plant, unless it is a surface growing fungus, in which case the roots spread over the surface of the plant. If the plants are covered with a good fungicide when the spores germinate the spores will be killed.

There are two general classes of insecticides. The first class of mixtures contains some poisonous substance that kills the insects when it is eaten with the foliage or fruit on which it has lodged. Paris green, London purple, and white hellebore are the poisonous materials most commonly used in these mixtures. These mixtures are effectual in destroying only those insects that eat the foliage or fruit of the plants, and are harmless to the insects that suck the juice of the plant.

The other class of insecticides kills the insect by coming in contact with the body. Kerosene emulsion, whale oil soap, and pyrethrum powder are the most common materials used in these mixtures. Mixtures of this class are used chiefly to destroy those insects that suck the juice of the plant and cannot de destroyed with poisons. The poisonous insecticides may be mixed with fungicides and applied all in one spraying, but other insecticides must be applied separately.

The fungicides and insecticides, if properly prepared and applied, have no effect upon the plants. If the mixtures are not correctly pre-

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pared and applied they do not form the desired protection to the plants and may damage the foliage and fruit. There is never enough poison on the well sprayed fruits and plants to alter their value for food. Most fruits are pared before eating and all sediment of the spraying material removed. In the case of fruits that are not pared before eating, as grapes, a person would have to eat from 350 to 500 pounds to get a small dose of poison. It will always injure the sale of such fruits, however, if there are any signs of a spraying material on them when placed on the market.

There are several kinds of spray pumps on the market that can be purchased for eight to twelve dollars that will do all the work on the average farm. The best form of pump for the ordinary farm orchard is a compact strong barrel pump. It should have a good sized air chamber and be capable of throwing a good quantity of water with great force. The working parts should be made of brass and if all parts of the pump that come in contact with the liquid are of brass the life of the pump will be greatly increased. Agitator attachments can be purchased as part of the pump or as separate machines. These attachments are very convenient but are not necessary; the agitation of the liquid may be done with a board, by hand.

The pumps should be supplied with about fifteen or twenty feet of one-half or three-quarter inch rubber hose for each nozzle attached. A good length of hose will save a great deal of time and trouble about reaching all parts of the trees and vines.

The nozzle should make a fine spray and be able to throw it several feet. There are two well defined groups of nozzles now in use. The first group forms the spray by forcing the liquid against an obstruction at the outlet of the nozzle. These nozzles throw a fan-shaped spray and most of them can be adjusted to throw a very fine spray or as coarse a spray as may be desired, or even a solid stream. These nozzles are easily opened and cleaned of any clogging material that may lodge in them, by adjusting them to throw a solid stream. This form of nozzle is best adapted for general use.

The second group of nozzles gives the liquid a strong rotary motion just before it leaves the nozzle. This causes the liquid to form a funnal shaped spray. These nozzles form a very fine spray and for

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applying liquids that are not liable to clog are a very good form.

The spraying must be well done if it is to be of any value. Slip-shod work will never pay. It is just so much time and material used and still the plants are not protected. The liquid must be applied in the form of a very fine mist or spray. If the liquid is thrown on the plants in large drops it collects and runs off, but if thrown on in a fine mist the foliage and fruit can be wet on all sides and but little liquid reach the ground. The liquid must be applied from every direction so that all parts of the foliage and young shoots will be wet. If the top of the tree is very dense the nozzle should be held in the center and the spray thrown in every direction. The work can not be done in a hard wind. The side of the plant next to the wind will be washed and the opposite side show little signs of the spray. The greater the power applied to the pump the better the form of spray thrown by the nozzle.

Spraying is a preventive and not a remedy. There are a few fungus diseases that can be destroyed by spraying but they can also be prevented by the same operation. The damage done by a disease or insect can be repaired only by the plant itself, and such work as can be done to protect it from further damage is about all that can be done for it. The spraying should be done early and the protection made complete before the diseases and insects appear. The first spraying should be done in the orchard, vineyard, and berry patches just before the growth starts in the spring. The second application should be made ten days or two weeks after the first and the third about two weeks after the second. If the orchard or vines are badly infested a fourth application should be made about two weeks after the third. If an application is followed immediately by a hard rain the application should be repeated as soon as possible. If this plan is followed and the work well done with properly prepared mixtures there will seldom be any need of further attention in this direction during the season. The solutions used in these sprayings should be a combined fungicide and insecticide, preferably Bordeaux mixture and Paris green. If the directions are followed they will meet the requirements for preventing about ninety per cent of the common fungus diseases and insects pests. There have been a great many spraying calendars published giving

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long lists of diseases and insects with specific directions for preventing each one. A careful examination of these calendars shows that a large majority of the treatments recommended are covered by those given above.

The Bordeaux and Paris green mixture is prepared as follows: Dissolve 4 pounds of copper sulfate (blue vitriol) in 2 or 3 gallons of water by placing the sulfate in a sack and suspending in the top of a jar or tub of water. Do not put this in tin or iron vessels as it will rapidly dissolve them. Before mixing dilute this to about 20 gallons. Slake 4 pounds of fresh lime by adding a small amount of water and after slaking is finished add about 20 gallons of water. Stir the lime and water thoroughly and strain before mixing. Pour these two solutions into the barrel or tank at the same time and stir vigorously while mixing. This may be diluted to 50 gallons and is the Bordeaux mixture. Make about one-fourth of a pound of Paris green into a thick paste with water and add it to the Bordeaux mixture and stir thoroughly and the mixture is ready for use.

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ANNUAL PRECIPITATION, (INCHES) OKLAHOMA.

Data furnished by C. M. Strong, Section Director, Oklahoma and Indian Territory Section, Weather Bureau, Oklahoma City.

STATIONS	COUNTY	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	Average
Ames	Woods	.....	.....	.....	.....	.....	.....	.....	30.97	.....	32.24	.....	23.78	.....	29.00
Arapaho	Custer	.....	.....	.....	.....	.....	21.47	31.03	25.19	26 69	35.64	28.92	29.36	18.23	27.07
Beaver	Beaver	.....	.....	.....	.....	.....	.....	.....	11.84	.....	.....	21.03	16.69	12.25	15.45
Blackburn	Pawnee	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	47.85	28.60	38.22
Burnett	Pottawattomie	.....	.....	.....	45 84	27.75	25.10	36.17	26.08	33.47	43.20	34.36	29.91	19.12	32.10
Clifton	Lincoln	.....	.....	.....	.....	.....	22.29	38.19	19.43	32.69	38.75	.....	.....	22.96	29.05
Ft. Reno	Canadian	31.91	28.79	26.77	33 51	29 40	18.28	22.78	19.13	25.56	.....	.....	37.12	19.18	27.58
Ft. Sill	Comanche	29.29	31.08	32.76	34.32	24.19	24.08	29.17	17.12	26,29	37.35	46 51	36.47	16.07	29 67
Guthrie	Logan	.....	.....	.....	.....	.....	22 99	30.69	31.71	.....	.....	32.62	29.83	19.33	27.87
Hennessey	Kingfisher	.....	.....	.....	.....	.....	.....	.....	.....	.....	37.73	35.19	29.89	19.32	30.53
Jefferson	Grant	.....	.....	.....	.....	.....	17.69	21.56	26.01	29.70	38.54	.....	27.81	.....	26.88
Jenkins	Woods	.....	.....	.....	.....	.....	.....	.....	.....	.....	28.26	30.61	28.42	18.92	26.55
Kingfisher	Kingfisher	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.73	34.45	30.56	26.13	32 71
Mangum	Greer	.....	.....	.....	.....	11.39	19.52	32.89	22.85	22.49	30.91	.....	.....	.....	23.34
Newkirk	Kay	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26.06	28.79	27.42
Norman	Cleveland	.....	.....	.....	.....	.....	.....	34.78	23.80	31.24	.....	.....	37.11	19.19	29.22
Oklahoma City	Oklahoma	.....	.....	37.43	42.29	24.28	26.72	32.49	21.90	28.47	35.88	43.66	31.45	15.74	30.94
Pawhuska	Osage Nation	.....	.....	.....	.....	.....	.....	.....	.....	.....	54.24	57.96	.....	24.54	45.58
Perry	Noble	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34.43	.....	24.04	29.24
Sac and Fox Agency	Lincoln	.....	.....	.....	.....	.....	.....	.....	25.95	.....	.....	.....	35.17	20.80	27.31
Stillwater	Payne	.....	.....	.....	.....	.....	.....	.....	.....	31.38	42.62	32.87	29.98	19.98	31.36
Waukomis	Garfield	.....	.....	.....	.....	.....	.....	.....	.....	.....	29.20	31.29	28 81	21.18	27.62

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FINANCIAL REPORT OF THE OKLAHOMA AGRICULTURAL EXPERIMENT STATION.

FOR THE YEAR ENDING JUNE 30, 1902.

Dr.

To Receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1902, as per Act of Congress approved March 2, 1887, ... $15000.00

Cr.

By Salaries	1	$ 5827.00
Labor	2	2957.65
Publications	3	1442.19
Postage and Stationery	4	669.21
Freight and Express	5	213.14
Heat, Light and Water	6	414.64
Chemical Supplies	7	218.84
Seeds, Plants and Sundry Supplies	8	197.03
Fertilizers	9	102.80
Feeding Stuffs	10	581.85
Library	11	14.70
Tools, Implements and Machinery	12	376.31
Furniture and Fixtures	13	276.89
Scientific Apparatus	14	32.76
Live Stock	15	555.67
Traveling Expenses	16	354.32
Contingent Expenses	17	15.00
Building and Repairs	18	750.00
Total		$15000.00

We, the undersigned, duly appointed Auditors of the Corporation do hereby certify that we have examined the books and accounts of the Oklahoma Agricultural Experiment Station for the fiscal year

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ending June 30, 1902; that we have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $15000.00 and corresponding disbursements $15000; for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving no balance.

And we further certify that the expenditures have been solely for the purposes set forth in the Act of Congress approved March 2, 1887.

(Signed:)

FRANK J. WIKOFF,
H. C. R. BRODBOLL,
T. J. HARTMAN,

Attest Auditors.

C. O. PEARCY, Custodian.

SUPPLEMENTARY STATEMENT.

Receipts and disbursements of Station Sale Fund.

Dr.

July 1, 1901, Balance	$ 838.93
To receipts from sale of station products	2500.00
Total	$3338.93

Cr.

By Labor	$ 322.87
Postage and Stationery	1.00
Freight and Express	32.43
Heat, Light and Water	0.60
Seeds, Plants and Sundry Supplies	5.00
Feeding Stuffs	1242.01
Live Stock	5.00
Traveling Expenses	38.25
Contingent Expenses	14.15
Building and Repairs	444.40
Balance	1233.22
Total	$ 3338.93

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PUBLICATIONS.

A few copies of each of the following publications are still on hand and will be sent in response to requests so long as the supply lasts.

No. 43, Nov. 1899—Fruits for Oklahoma.

No. 44, Dec. 1899—Field crops, 1899.

No. 45. Mar. 1900—An Annotated catalogue of the ferns and flowering plants of Oklahoma.

No. 46, May, 1900—Digestion trials.

No. 48, Dec. 1900—Crop and forage notes, 1900.

No. 49, Feb. 1901—A rhizomorphic root-rot of fruit trees.

No. 50, Apr. 1901—Manuring the soil.

Annual Report, 1900-1901.

No. 51. Dec. 1901—Feeding cottonseed meal to hogs.

No. 52, Dec. 1901 The potato crop. Variety tests of cabbage.

No. 53, June, 1902—Common parasites of domestic animals.

No. 54, June, 1902—The improvement of the castor plant.

Address all requests to

EXPERIMENT STATION.

Stillwater, Okla.

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INDEX.

PAGE

A

Admission to College 12
Agricultural department 9
Alfalfa in Oklahoma 34-37
Animal parasites 62-63
Annual precipitation 72

B

Bermuda grass 33-34
Blackberries 60
Blackleg 63-65
Board of Regents 4
Borers in soft maples 66-67
Botany and Entomology 9
Bran 43-45
Broomcorn 31-33
Buildings 19-21
Bulletins issued 18-19

C

Chemistry department 8
Correspondence 21-22
Cottonseed and cottonseed meal 48-53
Cottonseed, selection of 29-30
Courses of study 10
Cultivate trees 55-56, 59-60

D

Domestic Economy department 10

E

Equipment of College 8
Expenses at College 13

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F

Faculty of college 10
Fall planting of trees 56
Farmers' institutes 33
Feeding cottonseed meal to hogs 51–53
Feeding cottonseed products 48–51
Feeding wheat 37–39
Financial report 73-74
Fruit trees 53-54

H

Horticultural department 9

I

Insects, protection against 67-71

L

Language and literature 11
Library 8
Loco investigations 65-66

M

Mailing list 21
Manuring wheat land 27–28
Mathematics 11
Mechanical department 8

O

Opening of College 13

P

Pasturing Wheat 29
Plant trees and care for them 56-59
Potato growing 61
Precipitation, annual 72
Preparatory department 13
Press bulletins, summary 24-71
Progress of College 7
Protection against plant diseases and insects 67-71
Publications 75

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R

Rape for spring feed 34
Rations for fattening steers 45-48
Report of Director 14 23
Resources of college 7
Rutter pear 53
R. W. Munson grape 53

S

Selection of cottonseed 29-31
Short course 11-12
Shorts 43-45
Spray apple trees 54-55
Station Staff 4,22
Stock feeding 39-43
Subjects of investigation 14-18
Summary of press bulletins 24-71

T

Time of plowing for wheat 25-26
Time of seeding wheat 26-27

V

Vaccination to prevent blackleg 63-65

W

Wheat, effect of manure 27-28
experiments 24-28
feeding 37-39
meal, bran and shorts 43-45
pasturing 29
time of plowing 25-26
time of seeding 26-27
Wooly aphis 66

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13
4

OKLAHOMA

AGRICULTURAL AND MECHANICAL

COLLEGE

Agricultural Experiment Station

Twelfth Annual Report, 1902-1903

Stillwater, Oklahoma.

THE STATE CAPITAL CO., GUTHRIE, OKLAHOMA.

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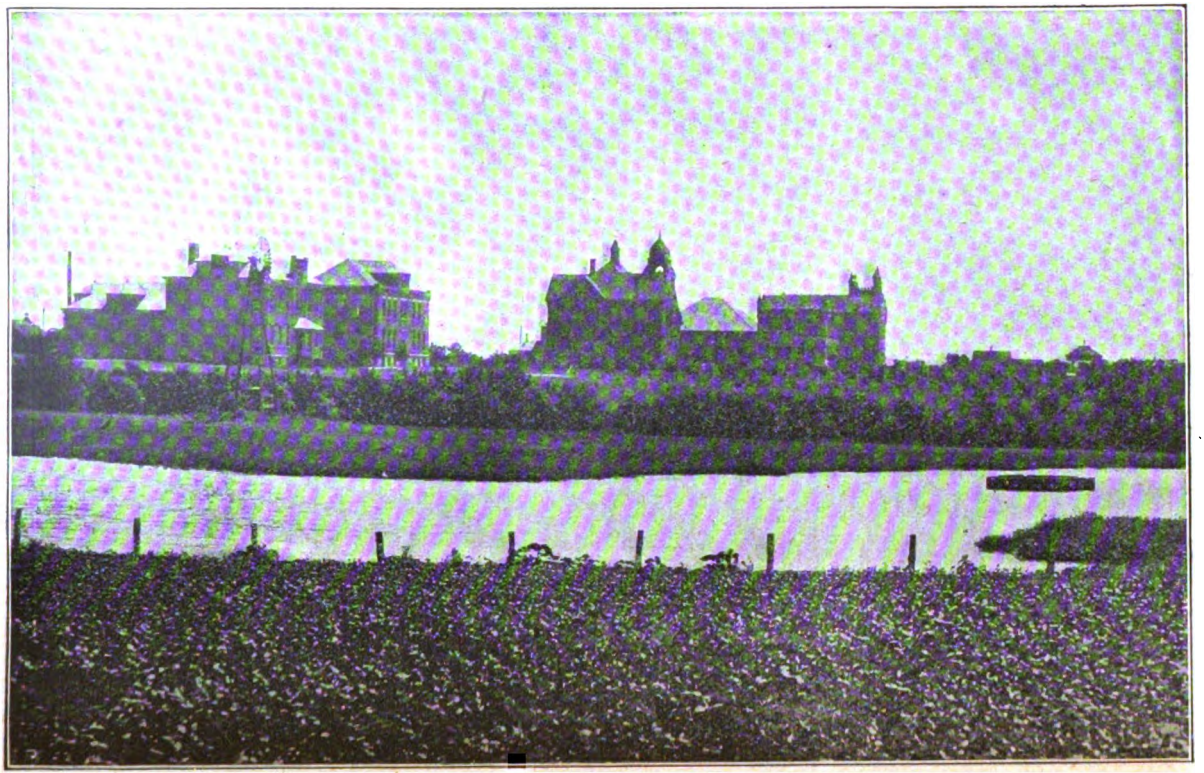

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OKLAHOMA

AGRICULTURAL AND MECHANICAL

COLLEGE

Agricultural Experiment Station

Twelfth Annual Report, 1902-1903

Stillwater, Oklahoma.

THE STATE CAPITAL CO., GUTHRIE, OKLAHOMA.

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Oklahoma Agricultural and Mechanical College

AGRICULTURAL EXPERIMENT STATION.

BOARD OF REGENTS.

GOVERNOR THOMPSON B. FERGUSON, Ex-Officio.....Guthrie
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F. C. BURTIS, M. S.....Agriculturist
O. M. MORRIS, B. S.....Horticulturist
W. R. SHAW, Ph. D.....Botanist and Entomologist
A. G. FORD, B. S.....Associate Chemist
L. A. MOORHOUSE, B. S. A.....Assistant in Soils and Crops
R. C. OBRECHT, B. S. A.....Assistant in Animal Husbandry
C. O. PEARCY.....Clerk and Stenographer

VISITORS ARE CORDIALLY WELCOMED AT ALL TIMES.

The publications of the Station are sent free to residents of the Territory on request. All communications should be addressed, not to individuals or departments, but to the

EXPERIMENT STATION, Stillwater, Oklahoma.

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LETTER OF TRANSMITTAL.

Stillwater, Oklahoma, July 1, 1903.

Sir:—

I submit herewith the twelfth annual report of the Oklahoma Agricultural Experiment Station, for the fiscal year ended June 30, 1903. In addition to a statement of the work which has been done during the year, and the financial statement as required by law, the report contains several articles on subjects that have a direct bearing on the agricultural interests of the Territory.

Very respectfully,

Governor T. B. Ferguson,
Guthrie, Oklahoma.

John Fields,
Director.

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Oklahoma Agricultural and Mechanical College.

PROGRESS.

Notwithstanding the extending of the age limit for admission to the preparatory department from fourteen to sixteen years, the attendance for the past year was not cut down as anticipated, the enrollment for the year standing at 435. The value of equipment for instruction, outside of buildings, stands at about $80,000, and the building equipment at approximately $100,000.

IMPORTANT CHANGES.

In addition to the regular courses offered in agriculture, horticulture, and domestic economy, and the short winter courses in agriculture and horticulture, a two years' course (of twenty weeks each) in agriculture, horticulture, and domestic economy has been established, to be known as the

SCHOOL OF AGRICULTURE AND DOMESTIC ECONOMY.

This course is arranged with a double purpose: First, to provide instruction in agriculture and domestic economy requiring less time than the four years' course, and yet more extensive and systematic than the eight weeks' winter course; second, to offer, in connection, such instruction in the common school branches as will prepare the student to enter the collegiate work. Applicants must be at least fourteen years of age, and fairly well advanced in the common branches, though they will be received and classified without formal examination. To meet the conditions of many young men and women in the country the course is arranged to begin on October 15, when the fall work on the farm ceases to be pressing, and to close March 15, when the services of the student are likely again to be needed at home. For those who can come at the opening of the fall term (September 10) and remain through the spring term, valuable review work in the common branches is offered, both in the four weeks preceding October 15 and the ten

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weeks succeeding March 15, preparatory to entrance to the sub-freshman class. Students who are reasonably proficient in the common school branches, and students of mature years, may take the agricultural and domestic economy work of both years in one, if they desire, and be excused from the other work of the course. The course is set out in detail on a subsequent page.

SUB-FRESHMAN CLASS.

The preparatory work heretofore offered in the institution will be given in the school of agriculture and domestic economy. The sub-freshman class, a part of the collegiate course, has been established to secure a higher degree of efficiency in the studies which underlie the more advanced collegiate work, particularly in English and mathematics. Applicants for this class are admitted without examination on satisfactory records from the eighth grade of city schools, or on diplomas from the common schools. Not holding these, they must pass a satisfactory examination in the following subjects: Reading, spelling, penmanship, geography, United States history, grammar, and arithmetic. Applicants for this class must be not less than fourteen years of age.

FRESHMAN CLASS AND ADVANCED STANDING.

Applicants for admission to the freshman class must pass an examination in the studies above mentioned, and in higher arithmetic, algebra to quadratic equations, physiology, physical geography, and general history. Students from high schools who have satisfactorily completed the ninth grade are admitted on trial without examination. Graduates of approved high schools are admitted to the sophomore class on their diplomas, without examination. The following important exception should be noted for the coming year: In order to deal fairly with those who have been taking the preparatory work, the best and strongest students have been passed to the freshman class. Similarly, for this year, applicants from other schools who pass thoroughly satisfactory examinations in the branches named for admission to the sub-freshman class will be received on trial in the freshman class.

BUSINESS COURSE.

Beginning at the opening of the next fall term, September 10, 1903, a complete business course will be offered to students having the quali-

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fications to enter the sub-freshman class. This course will include stenography and typewriting, bookkeeping in its several branches and specialties, commercial law, business forms, business correspondence, English.

COURSES OF INSTRUCTION IN DETAIL.

Three five-year courses are offered, namely, the General Science course, the Agricultural course, and the Mechanical Engineering course. In the General Science course the student may take the general scientific and literary studies which have heretofore been offered in the "General Science and Literature" course, or he may take majors in chemistry, botany, or zoology, covering exactly the same scope and character of work heretofore offered in the courses in chemistry and biology. The Agricultural course and the Mechanical course are specialized and technical courses respectively in agriculture, horticulture, and animal husbandry, and in mechanical and electrical engineering. Following are the courses in full:

GENERAL SCIENCE COURSE.

[The figures indicate the number of recitation hours per week; figures in parentheses indicate hours of practical work per week.]

SUB-FRESHMAN YEAR

FALL TERM	WINTER TERM	SPRING TERM
Higher Arithmetic 5	Algebra 5	Algebra 5
English 5	English 5	English 5
Physical Geography 4	Physical Geography (½ term) 4	Physiology 4
Book-keeping 5	Physiology (½ term) 4	General History 5
Spelling and Writing .....(2)	General History 5	Spelling and Writing .....(2)
	Spelling and Writing .....(2)	

NOTE: After fall and winter terms, students proficient in spelling and writing will take printing.

FRESHMAN YEAR

Rhetoric 3	Rhetoric 3	Etymology and Structure 3
German or Latin 5	German or Latin 4	German or Latin 4
Algebra 4	Algebra 4	Algebra 4
Physics 4	Geometry 5	Geometry 5
Sewing—women .....(4)	Sewing—women .....(8)	Cooking—women 2 (4)
Freehand Drawing .....(4)	Geometrical Drawing .....(8) (Men)	Stockjudging—men 1 (6)
Nursery Work—men 1 (2)		

SOPHOMORE YEAR

Advanced Rhetoric 2	Theme work 2	Theme work 2
German or Latin 3	German or Latin 3	German or Latin 3
Geometry 5	Trigonometry 5	Trigonometry 3
Chemistry 3 (4)	Chemistry 3 (4)	Chemistry 2 (4)
Zoology 3 (4)	English History—men 5	Botany 4 (4)
	Cooking—women 2 (6)	Surveying—men .....(4)
	Public Speaking .....(2)	English History—women 2

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JUNIOR YEAR.

English Literature 2	English Literature 2	American Literature..... 2
German or Latin 3	German or Latin..... 3	German or Latin 3
Physics.....4 (2)	Physics..... 4	Entomology or Chemistry } .....3(4)
Histology	Advanced Physiology	Cellular Biology
Botany	Botany	Botany
Feeds and Feeding	Farm Dairying	Crops
Civics and Constitutional Law } 10	Civics and Constitutiona Law } 10	Calculus } 10
Analytical Geometry	Analytical Geometry	Political Economy
Theoretical Chemistry	Organic Chemistry	Domestic Economy
Domestic Economy (women)	Domestic Economy (women)	Organic Chemistry
	Public Speaking..... .....(2)	Electricity

NOTE: The student is required to select any two of the subjects above included in brackets.

SENIOR YEAR.

Literature or Agricultural Chemistry } 3	Literature or Agricultural Chemistry } 3	Literature or Agricultural Chemistry } 3
Geology.....(4) 2	Advanced Book-keeping and Business Correspondence..... 3	Current History..... 3
Law 3	Bacteriology 2 (4)	Bacteriology 2 (4)
Social and Industrial History or Mineralogy } 5	Forestry or Metallurgy.... 5	Psychology, Botany or } 5
Botany, Embryology, Calculus, Chemistry, or Sociology } 4	Calculus, Botany, Chemistry, or Astronomy } 5	Industrial Chemistry }
		Thesis..... (10)

NOTE: The right is reserved not to give any elective offered during the junior and senior years for which fewer than five students apply, although the effort will always be made to accommodate every student in this respect.

AGRICULTURAL COURSE.

SUB-FRESHMAN YEAR.

The same as in General Science Course.

FRESHMAN YEAR.

FALL TERM.	WINTER TERM.	SPRING TERM.
Rhetoric 3	Rhetoric 3	Etymology and Structure 3
German 5	German..... 4	German 4
Algebra 4	Algebra 4	Algebra 4
Physics..... 4	Geometry 5	Geometry 5
Freehand Drawing.. 4	Wood Work.....(8)	Stock Judging.....1 (6)
Nursery Work.....1 (2)		

SOPHOMORE YEAR.

Geometry 5	Trigonometry..... 5	Trigonometry..... 3
Soils and Fertility 4 (2)	Pomology..... 2	Vegetables and Small Fruits 5
Zoology 3 (4)	Chemistry..... 3 (4)	Chemistry.....2 (4)
Chemistry.. ..... 3 (4)	Breeds 5 (4)	Botany.....4 (4)
	Public Speaking ..... (2)	Surveying..... (4)

JUNIOR YEAR.

Physics ..... 4 [2]	Physics 4	Entomology .....3 [4]
Feeds and Feeding 5	Farm Dairying.....3 [4]	Animal Breeding 5
Botany }	Botany }	Crops..... 5
Chemistry } 10	Chemistry } 10	Botany, Chemistry or Cellular Biology 5
Histology }	Advanced Physiology }	
	Public Speaking..... [2]	

NOTE: The student is required to elect any two of the subjects above included in brackets.

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SENIOR YEAR.

Agricultural Chemistry..... 8
Agricultural Physics.....4 [2]
Geology .....4 [2]
Law 3
Botany, Chemistry, or Embryology 4

Agricultural Chemistry..... 8
Bacteriology.....2 [4]
Forestry 5
Farm Economics 2
Advanced Book-keeping and Business Correspondence, or Research Work in Agriculture or Horticulture.....[6]
Evolution of Cultivated Plants..... 3

Agricultural Chemistry..... 8
Bacteriology .....2 [4]
Current History..... 3
Feeds and Feeding 3
Plant Breeding.....1 [2]
Thesis.....[10]

COURSE IN MECHANICAL ENGINEERING.

SUB-FRESHMAN YEAR.

The Same as in General Science Course.

FRESHMAN YEAR.

FALL TERM	WINTER TERM	SPRING TERM
Rhetoric 3	Rhetoric 3	Etymology and Structure....3
German.....5	German.....4	German 4
Algebra 4	Algebra 4	Algebra 4
Physics.....4	Geometry 5	Geometry 5
Freehand Drawing.....(4)	Woodwork.....(8)	Foundry and Pattern Making .....(8)
Nursery Work.....1 (2)		

SOPHOMORE YEAR

Advanced Rhetoric.....2	Theme Work 2	Theme Work 2
German.....3	Trigonometry 5	Trigonometry 3
Geometry 5	Chemistry 3 (4)	Chemistry..... 2 (4)
Algebra 2	Descriptive Geometry.....5	Descriptive Geometry....5 (4)
Chemistry.....3 (4)	Mechanical Drawing.....(6)	Mechanical Drawing.....(4)
Mechanical Drawing .....(6)	Public Speaking.....(2)	Surveying.....(4)

JUNIOR YEAR

Physics.....4 (2)	Physics 4	Electricity and Magnetism 4 (2)
Analytical Geometry.....5	Analytical Geometry..... 5	Calculus 5
Kinematics 3	Applied Mechanics 3	Applied Mechanics.....4
Steam Boilers.....3	Valve Gears.....3	Indicators.....2
Blacksmith Shop.....(8)	Machine Shop .....(10)	Machine Shop.....(8)

SENIOR YEAR

Calculus.....4	Calculus.....4	Current History.....3
Law.....3	Advanced Book-keeping and Business Correspondence 3	Thermodynamics.....5
Machine Design.....4 (4)	Machine Design..... 4 (6)	Machine Design.....4
Electrical Engineering...4 (6)	Electrical Engineering...4 (4)	Electrical Engineering.....3
		Thesis.....(10)

SCHOOL OF AGRICULTURE AND DOMESTIC ECONOMY.

[The figures indicate the number of recitation hours per week; figures in parentheses indicate hours of practical work per week]

FIRST YEAR

FALL TERM Ten Weeks—Beginning Oct. 15.	WINTER TERM Ten Weeks—Ending March 15.
Arithmetic..... 5	Arithmetic.....5
Spelling 3	Grammar.....4
Geography.....3	U. S. History 4
Writing..... 2	Veterinary Medicine, and Botany and Entomology 3
Livestock—Boys.....3	Domestic Economy—Girls 3
Domestic Economy—Girls 3	Veterinary Medicine, and Botany and Entomology—Boys.....(4)
Stockjudging—Boys.....(8)	Drawing—Girls.....(4)
Domestic Economy—Girls.....(4)	Domestic Economy—Girls.....(4)
Drawing—Girls.....(4)	

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SECOND YEAR

(Also preparing students for Sub-Freshman.)

Preliminary course, 4 weeks ending October 15. To be occupied with a review of arithmetic, spelling, geography, U. S. history, writing and grammar, as covered in first year.

BALANCE OF FALL TERM

Ten Weeks

Grammar.....5
Civil Government and Commercial Law 8
Arithmetic.....8
Horticulture & Floriculture, 8
Dairying.....2
Poultry 2
Gardening.....(2)
Dairying.....(2)

WINTER TERM

Ten Weeks, Ending March 15

Grammar 5
Applied Arithmetic.....5
Soils and Crops.....5
Stock Feeding—Boys.....8
Domestic Economy—Girls...8
Chemistry 8

Spring Term March 15 to June 1.

To be occupied with such studies as are necessary to fit for entrance to the Sub Freshman Class.

SHORT WINTER COURSES IN AGRICULTURE, HORTICULTURE, AND THE MECHANIC ARTS.

During a portion of the winter term practical instruction is given in matters directly related to farming, stock raising, and fruit growing, and the management of steam engines, with special attention to machinery used on farms. Any person over sixteen years of age may take this work, no examinations for admission being required. A circular describing the work of these courses in detail will be issued in November. In 1903 they will cover eight weeks from January 5 to February 26. The following list contains the work which will be given at that time.

Principles of Breeding—4 lectures.
Study of Breeds—10 lectures.
Stock-judging—10 lectures.
Diseases of Live Stock—18 lectures.
Stock Feeding—12 lectures.
Farm Dairying—9 lectures.
Crops for Oklahoma—18 lectures.
Farm Machinery and Equipment—12 lectures.
Steam Engines and Boilers—8 lectures.
Maintaining Soil Fertility—9 lectures.
Orchard and Small Fruits—18 lectures.
Troublesome Insects—9 lectures.
Elementary Botany—9 lectures.
Farm Hygiene; Water Supply—10 lectures.
Legislation and Laws Affecting Farmers—12 lectures.
Farm Accounts, Mortgages, etc.—12 lectures.

Work in blacksmithing, steam engines and boilers, veterinary practice, and practical horticulture will be given in the afternoon insofar as the facilities of the college will allow.

The lectures will be supplemented by practical work in the dairy, barns, shops, and orchards, designed to fix and illustrate the methods and practices advised. It is practical instruction throughout and planned to give the most that is possible in so short a time.

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CO-EDUCATIONAL.

This institution is open to young men and young women on equal terms. Since the establishment of the department of domestic economy, for the theoretical and practical training of young women in those things which will fit them for the duties of every day life in the home, it is noted that the percentage of attendance of young women is increasing.

LIBRARY.

The college has a well selected library of about 10,000 volumes. The books are kept in fire-proof stack rooms, and a commodious reading room is provided immediately adjoining. Students are permitted under proper restrictions to take books to their rooms. The best reference books and the leading periodical publications are at the disposal of students.

SCIENTIFIC AND OTHER APPLIANCES.

In chemistry, physics, mineralogy, botany, entomology, zoology, physiology, mechanical and electrical engineering, agriculture, horticulture, and veterinary science, and domestic economy, the college is equipped with the latest and best appliances and apparatus, representing an outlay by the government of approximately $80,000. Paramount stress is laid upon the experimental and practical work of the laboratory, and the afternoons are practically given over to this character of instruction. In agriculture and horticulture the live stock, the implements of husbandry, the green house, the forestry plantations, and the farm itself with its operations, constitute the laboratory. In mechanical engineering the wood working shops, machine shops, electrical shops, foundry, and blacksmith shops are in operation for practical work by the students. In chemistry the quantitative and qualitative laboratories are occupied by students practically every afternoon throughout the academic year. In botany and entomology the afternoon work is devoted to examination, analysis, and classification under the microscope. In zoology and comparative anatomy, practical work is given in the afternoon in connection with living, mounted, and unmounted subjects and with models. In bacteriology the laboratory work is devoted to the identification of bacteria, the action of disinfectants, the growing of colonies, the examination of substances for bacteria, etc. Freehand and mechanical drawing, bookkeeping, and surveying are also given in the afternoon. In domestic economy the

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kitchen, dining room, and sewing room are constantly occupied for practical work in these lines.

EXPENSES.

Tuition is free. An incidental fee of one dollar per term is charged students entering from Oklahoma and Indian Territories. A fee of five dollars per term is charged students under twenty-one years of age entering from elsewhere. Text books will cost from $3.00 to $5.00 per term. Special students in stenography and typewriting are charged $2.00 per term for use of typewriter. A deposit of $2.00 a term is required of all students in the Sophomore class in chemistry to cover laboratory breakage.

OPENING.

Entrance examinations for the fall term, 1903, occur September 8-9. Fall term begins September 10. For catalogue and full information address

A. C. SCOTT, President.
Stillwater, Okla.

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OKLAHOMA AGRICULTURAL EXPERIMENT STATION.

REPORT OF DIRECTOR.

No material changes have been made in the direction of the activities of the station during the past year. Several experiments are completed or have reached a point where results of permanent value are being secured. The results of an experiment in feeding corn, Kafir corn, alfalfa hay and Kafir stover to steers, covering three years, are being prepared for publication. Further experiments in feeding cottonseed meal, wheat and shorts to hogs have been completed. Three years' work with forage crops and grasses has resulted in extensive additions to our knowledge of these important sources of farm revenue. The planting of trees for posts, fuel, and windbreaks by farmers is being investigated and the results of this study, together with six years of experience along this line on the station grounds, will be summarized and published as soon as practicable.

The purchase of 160 additional acres of land by the College has given an opportunity for more extended work with pasture and forage crops, and provided better facilities for pasture experiments with steers.

The manufacture and free distribution of vaccine for the prevention of blackleg in cattle has been continued and has resulted in greatly diminishing losses from this disease. Provision has been made for paying the expenses incident to this work in the future from territorial funds.

SUBJECTS OF INVESTIGATION.

Experiments in the growing of field crops are being conducted along the same lines as stated in previous reports. Ten acres of bottom land have been leased for the purpose of making experiments with alfalfa and other crops on better soil than that afforded by the station upland farm. Feeding experiments with alfalfa and cottonseed products fed to steers, sheep, and hogs are planned, part of this being new and the remainder modified repetitions of previous experiments.

Small fruits are being investigated and variety studies are being made, both on the station grounds and in widely scattered commercial

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plantings. The influence of stock on cion, the pollination of fruits, tomato growing and varieties, and various methods of combating insects and fungus diseases are also receiving attention.

No results have been reached in the inquiry into the cause of loco poisoning further than additions to the knowledge of the distribution of the plants and practicable means for their eradication. Animal parasites, hog cholera, swine plague, and other diseases of animals, are being studied insofar as the facilities of the station will allow.

The first definite appearance of the Hessian fly in Oklahoma has been noted and active efforts are being made to obtain the data necessary for successfully combating this pest. The melon louse, which was very destructive last season, and the boll weevil, which is just beginning to appear in the Territory, are being studied with the hope of minimizing the damage from them. Experiments with castor beans looking toward the improvement of the yield, oil content, and habit of growth, are being continued and preliminary studies of cotton varieties have been instituted.

Necessary chemical control of all experiments is maintained and a study of the chemical composition of red and white Kafir corn is in progress. Miscellaneous water analyses and mineralogical examinations continue to require a large amount of work of doubtful utility. The station does not make assays for gold or silver and the expense of making quantitative analyses is charged in all cases.

BULLETINS ISSUED.

The following bulletins were issued during the year:

No. 55, December, 1902.

Bermuda Grass, by John Fields.

A summary of the results of experiments and observations and of the published statements of experiment stations, together with reports from ten counties in Oklahoma where trials of the grass have been made.

No. 56, December, 1902.

Garden vegetables, by O. M. Morris.

A report of the results of experiments with tomatoes, egg plant, onions, lettuce, radishes, salsify, beans, and peas, with cultural suggestions.

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No. 57, March, 1903.

Directions for the use of Vaccine for the Prevention of Blackleg in Cattle, by L. L. Lewis.

A report of the manufacture and distribution of blackleg vaccine by the station, the nature and distribution of the disease, the manner in which vaccine may be procured, and the mode of application.

No. 58, June 1903.

Fattening steers; Using Cottonseed, Cottonseed Meal, Wheat Meal, Wheat Straw, and Hay, by F. C. Burtis and John Fields.

A statement of the results from a feeder's standpoint and a summary of the chemical control of the experiment.

Press Bulletins, Nos. 86 to 97. These are summarized elsewhere in this report.

BUILDINGS.

No additions to the building equipment have been made during the year. The need for a building suitably to house the increasing work of the departments of agriculture, chemistry and horticulture and the administrative offices, mentioned in my last report, is strongly felt. It is essential for the development of the work of the station that such a building be provided. Two of the departments of the station are now housed on the second floor of Library Hall and the placing of the other three under one roof would materially increase the efficiency of the station's work. The rapid growth and development of the agricultural and allied work of the college is encroaching upon the space available for station purposes to an extent which makes additional room an imperative need.

MAILING LIST.

The mailing list of the station is increasing and has reached a size which makes the cost of printing a serious burden upon the station's resources. It is possible to print only a limited number of bulletins above those required by the list and practically all of the station's publications are out of print within a few months after they have been issued. It would be to the advantage of the farmers of the Territory if bulletins and reports could be issued in larger editions and more frequently but this cannot be done without appropriations for the purpose by the legislature. Quite generally, the states pay for printing the bulletins of their experiment stations.

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The addresses on the mailing list are classified as follows:

Oklahoma farmers	12,412
Indian Territory farmers	3,968
Outside	2,344
Local newspapers	254
Outside newspapers	129
Foreign	33
Total	19,140

The publications of the station are sent to all who request them so long as the supply lasts. A list of those still available will be found at the end of this report.

CORRESPONDENCE.

Valuable aid is being rendered by farmers of the Territory who supply the station with information concerning the adaptability of crops to different regions; results of trials of different varieties of fruits; the extent, character and area of forest tree plantings; insect ravages and fungus diseases; and general matters of agricultural interest. The large number of new settlers has added to the work of answering inquiries which is believed to equal in importance any other line of station work. Many farmers have visited the station during the past year and have thus come into closer touch with the members of the staff and gained a better understanding of the manner in which experiments are conducted and the general application of the results which are secured.

FARMERS' INSTITUTES.

A sufficient number of county institutes having been chartered under the law enacted by the sixth legislative assembly, a meeting of delegates was held in December, 1902 and six members of the Board of Agriculture were chosen. Under the terms of the law, the Secretary of the Board, whose office is at Guthrie, supervises the annual meetings of the institutes which are to be held at the county seats. Seven institutes were attended by members of the station staff during the year. The station will hereafter endeavor to send a representative to the annual metings of the county farmers' institutes, but available funds will not permit attendance at local institutes.

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THE STAFF.

In July, L. A. Moorhouse was appointed Assistant in Soils and Crops and in January, R. C. Obrecht succeeded J. S. Malone as Assistant in Animal Husbandry.

It is a pleasure to testify to the fidelity, earnestness, and efficiency with which the members of the staff have worked to make the station's efforts of real and permanent value to the agriculture of Oklahoma. Under the conditions which exist about a growing institution in a rapidly developing district, there is a vast amount of work which cannot be measured by concrete results. Long days of work have been required of the station workers and too often they have been burdened with a large amount of teaching in excess of what should have been required of them. But there has been a manifest disposition throughout to work for the station's efficiency and to avoid petty bickerings as to whom credit for completed work belongs. The results of completed investigations belong to the farmers of Oklahoma and whatever of credit there may be belongs to the experiment station.

C. O. Pearcy, Clerk and Stenographer, has resigned and his successor has not yet been chosen. J. F. Nicholson has been appointed Assistant in Bacteriology to aid the Veterinarian in the manufacture and distribution of vaccine. Provision has been made for the appointment of an Assistant in Agriculture.

JOHN FIELDS,
Director.

June 30, 1903.

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SUMMARY OF PRESS BULLETINS.

A press bulletin is sent out from the station on about the fifteenth of each month. These bulletins are sent only to newspapers and are intended to contain timely topics related to the work of the station and the agricultural interests of the territory. They are printed in many of the daily, weekly and agricultural papers of the territory and in agricultural papers elsewhere. The station is under obligations to those editors who have assisted in this manner and hereby gratefully acknowledges it. Some of the articles contained in the bulletins may have a permanent value and are reprinted in this report for convenient reference. They are, of necessity, fragmentary and, in part, a repetition of matter contained in regular station bulletins.

WHEAT EXPERIMENTS.

The wheat experiments in 1902 were a continuation of those started in previous years. At this station it is the policy to repeat all field tests for three to five years at least. This gives results under varying climatic conditions that will be encountered from year to year. The following are the results of the past season compared with those of former years.

VARIETY TEST.

This test was started in 1892-93 with 254 varieties, gathered from all sources where varieties of merit could be found. The less desirable varieties were soon weeded out and a list of about 65 tested for a time but in the last few years the list has been reduced until it now numbers 28. This includes the new varieties that have been introduced from time to time for testing. After testing a majority of the above number for 10 years, and all newly introduced varieties for varying periods, we are unable to find any so-called best variety, a variety that will give materially better yields than all other varieties year after year. The fact is evident from our experiment that there is quite a list of varieties that differ but little in the amoun of grain they produce, and any of them may be relied upon for goo

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yields when proper cultivation and seed selection is followed, although these varieties differ more or less in other characteristics. Again the variety test demonstrates that variety selection is important as there are certain varieties that usually fall below the yields of othres. The farmer who is searching for the variety of wheat that will counteract all the bad results of his shiftless ways of cultivation and seed selection, and produce a good yield without fail, cannot find it in our list. Success with any good variety of wheat will depend very largely on how the farmer prepares his land and how he selects his seed and how this is followed up each year. The best variety will soon deteriorate when grown in the careless way that is practiced on the average farm. Old standard varieties that have been grown on the Station farm for the past ten years, give as good yields today as the newly imported varieties from the great wheat growing districts of the world. In looking for a new and better variety, the matter of better seed selection and tillage should be looked into and adopted if the standard of the variety is to be maintained. The highest yield in the variety test the past season was 24 bu. per acre. Of our standard sorts the lowest yield was 15 bu. This was one of the so-called May wheats, very early in maturing, and the extremely low yield in this case is attributed to the fact that it was heading during a dry spell that the later varieties missed more or less. Seven varieties yielded from 22 to 24 bu. per acre; eleven 20 to 22; and the balance went below 20 bu. The following is a list of our best varieties that have been tested six years or more; Red Russian, Fulcaster, Fultz, Turkey, Early Red Clawson, Sibley's New Golden, Missouri Blue Stem, German Emperor, Big English, and New Red Wonder. The following varieties with from one to two years test have given promising results, viz; Weissenburg, Oregon Red, Eversaw, Crimean, and Gypsy Amber.

Two varieties of spring wheat were tested but both yields were below the poorest of the fall wheats. One yielded 14.5 bu. per acre and the other 10 bu. The variety yields the past year were a little over half what they were in 1900 or 1901. In the former year the yield ran from 37 to 44 bu.; in the latter 29 to 39 bu. The quality of the berry this year was fair, the test running from 58 to 59 lbs., for uncleaned wheat.

One of the new varieties in our test, the Weissenburg, is of special interest. The seed of this variety was imported from Hungary by the U. S. Dept. of Agriculture. The wheat raised in that district is the source of the flour that sells on the Liverpool market for $1.00 more

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per bbl. than any other flour. The past season on the small plats in our variety test it yielded 19 bu. per acre, while eighteen other varieties ran from 2 to 4 bu. more than this. On large patches distributed over the farm the yield ran from 13.5 to 20 bu. per acre. The low yield was on richly manured ground, where the straw lodged badly. This variety has been grown on the Station farm for the past three years, and gives every promise of being a good wheat for this country. It is one of the hard wheats that is making Oklahoma flour so much sought after, and after a milling test is made, it may be found of greater value. Considerable seed of this wheat has been sold to the farmers over the Territory, and its value will be more widely tested.

The Station has no seed wheat for sale this season.

WHEAT, CONTINUOUS, WITH AND WITHOUT MANURE.

A half-acre plat that had been cropped to wheat continuously since 1892-93 without manure of any kind being added to the land, yielded 15.3 bu. per acre, in contrast to a yield of 17.4 bu. from a half-acre plat cropped the same way, but that had manure applied at the rate of 15 tons per acre in 1898, and 11 tons in 1899. The season before, the difference in favor of the manured ground was 10 bu. per acre, for the season of 1900-01 it was 18 bu. in favor of the manured land, and for 1899-1900, the same; making a difference of 48 bu. in the four crops in favor of the manured land. The best of tillage has kept the unmanured plat up to the present standard, but there are many indications that the continuous cropping is depleting the soil fertility.

EARLY, MEDIUM, AND LATE PLOWING.

For the past three years plats have been plowed approximately the middle of July, August, and September. The different plowings are all seeded on the same day and the plats given like treatment in all other respects.

The seeding for this year's crop was made October first with Fulcaster wheat at the rate of 1 1-2 bu. per acre. The land where these plats were situated was very thin and poor. The past season the July plowing yielded 17 bu. per acre; the August plowing 18.1; and the September 19.3. The difference between plats is small and probably is no more than what could be accounted for, due to inequality of soil on different plats. In the season of 1900-01 the July plowing

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yielded 43.6; the August, 38.2; the September, 40.2 bu per acre. In 1899-1900 the July plowing yielded 31.3; the August, 23.4; the September, 15.3 bu. per acre. The average for the three years stands as follows: July 30.64; August 26.59; September, 24.93 bu. per acre, making a difference of about 4 bu. in favor of the July plowing over the August, and about 6 bu. over the September plowing. Our experience in wheat culture is that in six years the difference in favor of July plowing will be considerably greater than the above. In the above test in the last two seasons, two out of three afforded unusually favorable conditions for getting late plowing in shape for seeding. Rains fell after the late plowings, which made it possible to get the land in fair shape for seeding, although at the time of plowing it was dry and lumpy. And probably on our plats the showing for late plowing is better than can be obtained on a large field of like soil, as we had but small patches of ground and could get onto the land at the proper time after a shower and work it down in shape, while a large field could not have been gone over in time to do much good. Again we put more labor in harrowing and discing on the late plowing than the average farmer would be willing to do. The early plowing always requires much less labor than the late. Considerable will depend upon the character of the soil and much upon the season that follows, and the amount of work that is put on the land after plowing, as to how much difference there will be between early and late plowing for wheat, but the safest rule is to plow as soon as possible after the previous crop is removed.

EARLY, MEDIUM AND LATE SEEDING.

For the past three years two large plats have been seeded about the middle of September, two the middle of October, two the middle of November.

For the season just past the yields were as follows: September seeding, 23.1 bu. per acre; October's 22.9; November's 11.2 bu. per acre. The ground was all plowed at the same time and treated in all other respects the same on the different plats. The average of the yields for the three years runs as follows: Sept. seeding, 32.2; Oct. 31.8; Nov. 20.5 bu. per acre. Besides being much smaller in amount, the grain from the November seeding is always very inferior in quality. Aside from the value of the fall pasture that the early seeding affords, the October seeding is generally about as good as that in

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September. If the seeding is deferred later than the middle of October the difference is likely to be greater, and considerable risk is taken. During one season of these experiments the growth of the wheat seeded the middle of September was so rank in the fall that the plants were damaged. This was during the fall of 1900 when there was an unusually heavy rainfall in September and the wheat was on fairly rich ground. If this condition occurs, pasturing will offset all ill-effects, so it is no drawback to September seeding.

The November seeding makes very little start in the fall, no root growth or tillering to speak of, and is in effect spring seeding.

The season of 1901-1902 was a little below the average for a wheat crop. Commencing with July the rainfall was below the average during most every month up to March. In this month the rainfall was almost double the average and it brought out all the wheat that had lived through the winter in fine shape. The excessive rainfall of May, 10.86 inches which fell while the wheat was in bloom, probably was as much the cause of the light yield as any other factor. The ground was water-soaked and soggy for weeks, and about the time the wheat was ripening, the ground got hard and dry. Chinch bugs had no material effect on the crop and the damage from rust was very slight (July, 1902.)

WHEAT SEEDING.

Unless some unusual condition exists, the station seeds wheat at the rate of one and one-half bushels per acre. Covering a period of several years at this station different amounts varying from three to eight pecks per acre were seeded on different plats to furnish data on this question. The average of these results shows a few bushels in favor of the five and six peck rates, but there were cases in which there was practically no difference in yields from the lightest to the heaviest seeding. On the other hand there were times when such unusual rates as three pecks and eight pecks gave much poorer results than a medium amount. Similar experiments have been carried on by many of the stations over the United States and the results agree very closely with those given above and all recommend a good liberal seeding as being the safest rule to follow. Conditions have been found to influence the results very much at times, so that any fixed rule cannot be laid down,

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and the farmer should give each individual case due consideration as many poor yields have been the result of not using the proper quantity of seed wheat per acre. The following factors are to be considered in deciding the rate of seeding; time of seeding, character and condition of soil; location, character of seed, (quality, size of berry, purity), method of seeding and variety characteristics. Before considering these it is well to recall to mind that wheat, like other small grains, has the characteristic of throwing out from each seed, stalks varying in number from two to several dozen, in extreme cases. The number usually runs as high as half a dozen at least. This is the tillering or stooling of the plant. Due to this habit of growth the number of seed stalks per foot may not vary much even if different amounts of seed are used per acre, and consequently the yield per acre may not differ materially. But much will depend upon the factors cited above whether we get the proper number of seed stalks per foot or whether they produce the maxium amount of good grain. If any condition exists that stimulates or allows an abnormal amount of tillering, it is usually detrimental to the yield and quality of the grain, as will be noted later, but it is well to state here that the injury is seldom due to there being too many stalks produced per foot as the tendency is to produce about so many seed stalks per foot and then the tillering ceases. Where certain conditions have existed or followed thin seeding, too few seed stalks have been obtained to produce the maximum yield, as will be noted later.

The time of seeding has great influence upon the tillering of the plants. Early seeded wheat affords time for the tillering, while with late seeding, cold weather stops growth in many cases before the desirable amount of tillering has taken place. As a rule, wheat seeded after the middle of October in Oklahoma tillers but little in the fall, and November seeding not at all. If the land is in good condition and the following spring is favorable, much may be made of them, but as a rule the stand will be too thin and irregular from late October or November seeding when the usual amount of seed is used per acre, and consequently seven to eight pecks per acre should be used for seeding at these times.

If the land has been put in good tilth by early plowing and frequent harrowing, lighter seedings may be used than where the ground is loose, cloddy, and dry. In the latter case many of the seeds will not grow and the conditions are not likely to be favorable to produce the proper amount of tillering, and the usual amount of seeding should be

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increased by a peck or half a bushel. There are dry seasons when the best prepared soils do not contain sufficient moisture to produce regular growth, and an increase in the rate of seeding should be made at such times.

A fertile soil will stimulate and support more tillering than a thin soil, so under usual conditions more seed should be put on a thin soil than on a fertile one. There are conditions under which an extra heavy seeding may be more desirable on a rich soil than the usual rate. Where the grain is inclined to lodge, very thick seeding will dwarf the stalk enough to lessen this damage very much.

In the districts of light rainfall, the number of plants per square foot should be less than in a humid region, as a thick stand would suffer more than a thinner stand would when there was a lack of moisture in the soil. But in these localities the tillering is less and the growth of the plants smaller so the usual amount of seed is generally used.

The size of grain varies in different varieties and more or less with the season and soil. Determinations with the common varieties have shown that it is possible to have as many grains in a half bushel of one variety as are in a bushel of another. Hence the smaller the grains due to this cause the less seed should be used per acre. There will be more grains in a bushel of shriveled wheat than in a bushel of plump wheat, but there are many cases in which the rate of seeding should not be reduced as the vitality or germinating power of such grains is poor and more seed would be required. This can be decided by sprouting a hundred seeds.

Seed that is full of trash and weed seed, if it is used at all, must be put on more liberally, as all this material occupies space.

The drill has lessened the amount of seed necessary from one to two pecks per acre over the old method of broadcasting, but the latter is used so seldom now that further mention is unnecessary. Whether the seed is weighed or measured out for seeding should be taken into consideration, or the number of grains put on an acre may vary considerably. Again many drills do not put on the amounts designated by the gauges and the amount put on will vary, due to the depth the drill is set. All of these points should be worked out by the operator.

The tillering habit differs quite materially between varieties. In some it is very strong and as much seed of these varieties would not be required as those in which this characteristic was not so well developed. Many have noticed how profusely the Turkey wheat tillers.

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Although the question of the amount of seed per acre is not as important as some others, it is too often passed over by our wheat growers. The saving in most cases may be only slight, but it is the little savings that are made regularly that count for most. (October, 1902).

THE OAT CROP.

The oat crop has yielded well in Oklahoma for the past three years and has brought good prices. The average of the yields on the experiment station farm was as follows: 1900, 72 bu.; 1901, 41 bu.; 1902, 54 bu. per acre. The variety used in these trials was Texas Red, one of the very best varieties tested and one most commonly grown in Oklahoma. This variety is used exclusively for the general crop on the station farm. Early maturity and only a moderate growth of strong straw are the very desirable characteristics possessed by this variety. The best varieties lately introduced from the north have not yielded as well.

The plats on which the above yields were secured were seeded as follows: 1900, March 2; 1901, March 1; 1902, March 4. Early seeding has been found to be very important as it usually gives much the best yields. If the season is not backward the seeding should begin by the middle of February and be finished not later than the middle of March. Many sow earlier than the middle of February, but little is gained by this except to get the work done, and there is seldom any loss from this extra early seeding. Oats may be soaked in water, allowed to germinate, and to freeze, and still they will grow. If the plants have been up several days and growth has continued until the substance is all out of the seed and the plant not yet well-rooted, a hard freeze will kill many of the plants. But this is the only condition under which early seeded oats will be damaged by a freeze and this happens so infrequently that there is little risk and this is counterbalanced by the advantages of early seeding.

Quite frequently, volunteer oats have lived through the winter in Oklahoma, but all of advertised winter varieties tested by the station have proved as tender as the common ones and have produced very small yields.

Oats do best on a compact, well-settled seed bed and whatever method is necessary to obtain it at seeding time should be followed. This

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is almost impossible on loose, sandy soils and as a rule, oats do not yield so well on such soils as on those of a heavy type. On loose soils, it is not usually advisable to plow for oats. On heavy soils, plowing for oats will leave the land in better condition for future work, and if done at the proper time and followed by the proper treatment, is advisable but not necessary for good results, especially if the land was well tilled the previous season. If oat ground is to be plowed, it should be done in the fall or early winter so as to give it time to settle. Spring plowing will often give as good results if it is well worked down with a drag and if heavily rains fall so as to settle the soil before the spring drouth. Because of the rush of work and the risk of not getting the seed bed fine enough, spring plowing for oats is not usually advisable. The ground may be gone over thoroughly with a disk or cultivator before the seed is put on. If the season is a dry one, care should be taken that the soil is not allowed to dry out too much after this is done and before the seed is put in and the soil worked down again.

Oats are quite generally broadcasted but the results are surer and more uniform if the drill is used. Ground is not in fit condition to be put in oats if the seed cannot be put in with a disk drill. The experiment station seeds oats at the rate of three bushels per acre. In the experiments mentioned above, this amount of good clean seed was put on with a drill and the soil was in the best of tilth. A good, liberal seeding gives a good thick stand that keeps down all weeds and the plants do not tiller profusely as when thin seeding is followed. With thin seeding, the sucker stalks are much later and more irregular in ripening than the seed stalks and are usually damaged by rust. When enough seed is used to make very little tillering necessary, the plants all ripen at the same time and earlier and hence the yield and quality are much better. Results will be influenced by the character of the seed the condition of the seed bed at the time of seeding, and the method of seeding. The poorer the conditions the more seed should be used. The oat crop should be included in the rotation on every Oklahoma farm, not so much because it is a cash crop to be sold from the farm as for its value in the rotation and its feeding value on the farm. (January, 1903.)

ALFALFA IN OKLAHOMA.

The experiment station has received numerous reports from farmers who made a success of spring seeding of alfalfa. One farmer in

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Woods county secured a good stand on newly broken sod and prefers this plan for sandy land for the reasons that weeds and moles are less troublesome and the soil does not blow as it does when the land has been in cultivation for some time. The correspondence of the station indicates that there will be a large acreage of alfalfa seeded this fall. As a hay crop, alfalfa has no equal and small areas of it are now being grown with success on almost every type of soil in Oklahoma. It is coming to be understood that it will not do to pasture alfalfa and that it is a hay and not a pasture crop. An unwarranted prejudice against alfalfa was caused by early attempts to grow it for hog pasture. Many instances have been observed where farmers seeded an acre or two of hog lot to alfalfa and turned the hogs in as soon as the alfalfa was six inches high. Of course, the alfalfa did not last a week and was pronounced a failure. There are some soils with open subsoils and water close to the surface that grow alfalfa that will stand pasturing. But these soils are not common. A field of alfalfa in the spring is tempting when the crop is green and growing while all else is brown and it is at this time that much harm is done by pasturing. The tender growth of the plants is eaten off, thus weakening them and giving a good opportunity for weeds and crabgrass to grow and smother the alfalfa. There are many forage plants that may be grown for hogs. Wheat, rye, oats, rape, sorghum, cowpeas, and soy beans, if properly utilized, may be made to furnish succulent forage throughout the year for the hogs without running the risk of ruining a good stand of alfalfa by pasturing them on it. (September, 1902.)

SPRING PASTURING OF ALFALFA.

After it is too late to pasture wheat that is to be cut for grain and before the grass pastures begin to furnish feed is a period of a month or six weeks when the temptation to pasture alfalfa is hard to resist. Pasturing during this period is about the surest way of destroying a good stand of alfalfa. Aside from the weakening of the plants brought about by the removal of the first tender growth, the ground is kept bare and crab grass and weeds are allowed to get a good start ahead of alfalfa. The longer the pasturing is continued, the more serious are the harmful effects. Many farmers in Oklahoma think they have tried alfalfa when, after securing a good stand by fall seeding, they have lost it by pasturing early the following spring. It takes

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about three years for alfalfa to become thoroughly established and during that time it should not be pastured at all. It would be better if it were never pastured, especially on uplands, and were used exclusively for hay. The experiment station has been tracing the causes of failures to succeed with alfalfa, and in nearly every instance that has been observed, pasturing, especially in the spring, has been one of the chief reasons. (February, 1903.)

BERMUDA GRASS.

A recent bulletin of the experiment station makes the following statements concerning Bermuda grass:

Of all the grasses tried on the station farm, Bermuda alone has shown the qualities which must be possessed by a pasture grass in Oklahoma.

While it is possible to eradicate Bermuda grass when well established, it should be started only on lawns or on land intended for permanent pasture and should be kept out of fields intended for cultivation. In ten years on the station farm, Bermuda grass has not spread to a troublesome extent into lands where it was not wanted.

Bermuda grass should be given a trial on every Oklahoma farm where permanent pasture is wanted. A small start may be secured from seed which may be purchased of Southern seedsmen. This will furnish a supply of sod so that larger plantings may be made in succeeding years by covering pieces of roots in March and April, or even as late as August.

This and other publications of the station will be sent free to all applicants. (February, 1903.)

The experiment station is receiving many inquiries regarding the extent to which Bermuda grass was affected by the past winter. With the exception of two plats which were started from the same lot of seed, all of the Bermuda grass on the station farm began growing from March 15 to April 10, depending upon the exposure and the covering of grass which was left for protection during the winter. The two plats mentioned were very slow in starting and portions of them appear to be killed, though it is possible that they may finally come as they have in former years. The station has received a few reports from farmers in western Oklahoma who state that much of the Ber-

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muda grass was winter-killed. More of these reports are wanted and it is hoped that all farmers who have Bermuda grass will write a postal card to the station giving the area in grass, when started, and whether from seeds or roots, time growth started this spring, and present condition. If enough reports are received, it will add to the stock of information about the hardiness of this grass which promises so much as a means of replacing the native grass pastures which are rapidly deteriorating under heavy pasturing. (May, 1903.)

MAKING BLUE-GRASS LAWNS.

Oklahomans who came from northern states are persistent in their efforts to secure a sod of Kentucky blue-grass on their lawns. Where grown successfully, blue-grass is one of the most satisfactory grasses for the lawn. Its establishment in Oklahoma is, however, a matter of extreme difficulty.

The usual experience is that the seed germinates well and a fine stand is secured. When the weather becomes hot, much of the blue-grass turns brown and dies and crabgrass and weeds fill in the spaces. Usually isolated bunches of blue-grass survive and seem to withstand all sorts of unfavorable conditions. The usual custom of keeping the grass and weeds cut short prevents the blue-grass from spreading. It is in these small bunches of blue-grass which survive that the hope of the lawn-maker lies. Many cases have been observed in which the blue-grass was allowed to mature seed which was then cut and scattered over thin spots. By keeping this up through several years, nearly perfect stands of blue-grass have been secured. The rainfall during the past fourteen months has been quite heavy and conditions have thus been favorable to the growth of blue-grass, but lawns that were set by this method went through the exceptionally hot and dry season of 1901 without serious injury.

Those who lived in Iowa and eastern Kansas before moving to Oklahoma tell of their repeated failures to grow blue-grass there until after the "wild nature got out of the soil." Is it not more probable that the few plants which survived from each sowing produced seeds which were better acclimated and in turn produced hardier plants? Under normal conditions, seed produced in a given locality is better adapted to successful growth there than seed bought from distant places.

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It seems more reasonable to suppose that, this rather than the elimination of the mythical "wild nature of the soil," accounts for the success with which blue-grass now grows in Iowa.

Oklahoma lawn-makers who prefer blue-grass to Bermuda grass are advised to sow purchased seed, both in the spring and in the fall; to pull the weeds and crab-grass to prevent their seeding; and to allow the small bunches of blue-grass which survive to mature seed which should be cut and scattered over thin places. Moderate shade is almost essential for the growth of blue-grass here and with it, the above may possibly result successfully. (May, 1903.)

PEANUTS.

There is much interest in peanuts as one of the many minor crops which may be grown in Oklahoma. While their culture has not been extensive, except in a few localities, many farmers grow a small patch each year. Peanuts are grown either for the nuts and vines, the former being sold and the latter fed to cattle, or for hog pasture.

The Spanish variety is usually grown in Oklahoma. It has a small upright vine and forms small pods near the tap root. Other varieties are the Virginia running and the Virginia bunch. A sandy loam soil that will not stain the pods is best for growing peanuts for market, though if good attention is given to preparation of the land, profitable crops may be secured on a great variety of soils. The soil should be prepared as for any other clean culture crop, care being taken that a good seed bed is provided. About two bushels of nuts in the pod are required per acre for seed. They may be planted in the pods but it is better to hull the peanuts avoiding breaking the skin of the kernel. Planting may be done as soon as danger from frost is past and plantings late in June have given paying yields at the experiment station, the crop not being seriously damaged by dry spells if the ground is in fair tilth. When rains come, the plants often go to fruiting again.

Many methods of planting are successful; perhaps the one most generally used is to plant in rows two and one-half to three feet apart with one seed every twelve inches in the row. Clean cultivation should be given as often as necessary to keep down the weeds and preserve a loose surface. Sometimes the rows are hilled up forming ridges but this plan does not usually result in greater yields than where level culture is given.

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If the crop is planted for hog pasture, the hogs may be permitted to do the work of harvesting after the pods are nearly mature. While hogs do not eat the vines readily, they are very fond of the nuts and every hog raiser should have a patch of peanuts to add to the variety of food for the hogs.

If the crop is prepared for market, the harvesting should be done before frost. For rapid work, an implement with a cutter to run beneath the plants, cut off the tap roots, and loosen the soil, is necessary. The loosened vines with peanuts attached should be forked into windrows and when partially dry, placed in small bunches or stacks. If the crop is to remain long in the field, the stacks should be covered with straw or hay to keep out the rain. Where only a small acreage is grown, the peanuts may be picked by hand but where grown on a commercial scale, a peanut thrasher is essential. The peanut straw, if in good condition, has considerable feeding value for cattle and is an important feature of the crop.

While it is doubtful if many farmers would find peanut-growing profitable on a large scale, it is certain that many could grow a small acreage to advantage. The demand for peanuts is limited but the crop may be fed on the farm if it cannot be sold at a profit, which is a positive advantage over broom corn and castor beans. (April, 1903).

TEST THE SEEDS.

At this time of year seed should be procured and prepared for the coming season. If put off until a later time, because of the delays that arise during the rush of spring shipments and spring work, the seed may not be on hand at the proper time, the seeding will be late, and smaller yields will be the result. This is the proper time to investigate the vitality and germinating power of seeds. This should always be done unless there is no question about the matter, and there usually is; and the cost of a test is but a trifle. Purchased seed should always be tested. Seed may have been put away in storage in proper condition, but it may have absorbed moisture from the air, the ventilation may have been poor, and the seed may have been injured by molding or heating or freezing. If such seed is used and the usual amount is sown, the stand is poor and irregular, and a low yield is the result.

The weather during the fall of 1902 was hard on the vitality of

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seeds, and even where the best of care has been taken, the per cent of germination may be low. Where the seed has been neglected the per cent of germination may fall below fifty. The rainfall was frequent and heavy and much of the seed was soaked in the field. Freezes do much damage while seed is in such condition. Much poor seed will be sent out the coming season and it is very necessary that seed be tested before planting.

A simple germinating apparatus can be made from two ordinary plates and a piece of flannel cloth. Fold the cloth and lay it in one plate, placing the seeds between folds of the cloth, which should be moist, but not dripping. Cover the whole with another plate inverted and stand in a warm place. If the test is made during cold weather care must be taken to stand the plates where the temperature will not fall much below fifty degrees Fahrenheit at night and will be about sixty-five or seventy degrees during the daytime.

The seeds that have sprouted should be removed every day and the number recorded. When the test is completed the number of seeds sprouted can be compared with the number put in the test and the percentage of germination determined. Cereals, and alfalfa should be tested for about ten days, while grass seeds need fourteen to thirty days. (January, 1903.)

USE THE STABLE MANURE.

While there is quite a noticeable improvement in the extent to which stable and barnyard manure is used on the farms of Oklahoma, much of it, especially in the neighborhood of towns and cities goes to waste. During winter is a good time for hauling out this manure and spreading it over the fields. There can be no question as to the profit to be had from liberal applications of manure. Farmer's should give serious study to methods of maintaining and improving the fertility of their farms. Bulletin No. 50 of the experiment station contains many valuable suggestions along this line and as long as the supply lasts a copy will be sent free to each applicant. (January, 1903.)

COTTONSEED OR COTTONSEED MEAL?

There is much difference of opinon and consequent discussion among farmers who grow cotton as to the manner of feeding and rela-

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tive value of cottonseed and cottonseed meal. The tendency always is to utilize for feed the products of the farm and this is generally a safe and a desirable practice.

Cottonseed meal is one of the products resulting from the manufacture of oil from cottonseed. Oil, hulls and linters are the other products. The short cotton that sticks to the seed is first removed, then the hull is separated and the resulting hulled seed is ground, heated, and pressed. After all of the oil obtainable by heavy pressure is secured, the cakes from the presses are ground into the product known as cottonseed meal. It is not cottonseed meal in the same sense that ground corn is corn meal or ground Kafir corn is Kafir meal. The cottonseed meal produced by the oil mills differs greatly from ground cottonseed and this fact should be kept in mind when discussing the uses which may be made of this feed. The only difference between corn and corn meal is that of digestibility. The chemical composition of each, if from the same lot of corn, is the same. But cottonseed and cottonseed meal are entirely different in composition. Cottonseed contains, in each hundred pounds, twelve and a half pounds of protein and nearly sixty-nine pounds of carbohydrates and fat and has a nutritive ratio of 1:5.2. Cottonseed meal contains, in each hundred pounds, thirty-seven pounds of protein and forty-four pounds of carbohydrates and fat and has a nutritive ratio of 1:1.2. The term, nutritive ratio, means the proportion existing between the protein and the carbohydrates and fat in a feed or ration. For general purposes, the grain ration which is fed should have a nutritive ratio somewhere between one to six and one to seven.

Thus, neither cottonseed nor cottonseed meal is suitable to feed as an exclusive grain ration but should be fed mixed with some grain richer in carbohydrates, such as corn, Kafir corn, or wheat. If cottonseed is fed, at least an equal amount of one of these other feeds should be mixed with it. Both of the feeds will then be utilized to better advantage than either alone. Cottonseed meal should never be fed alone except possibly to stock cattle that have plenty of roughage and are not receiving other grain. In general, cottonseed meal should be mixed and fed with about three to five times as much corn, Kafir corn or wheat.

Whether to feed cottonseed or cottonseed meal depends on the market prices of each and of corn, Kafir corn, wheat, and rough feed. These prices vary so greatly in different localities that no general statement which will apply in all cases can be made. The ten-

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dency appears to be toward feeding cottonseed without inquiring into the possible advantages of selling the seed and buying cottonseed meal. Pound for pound, when fed in connection with other grains, cottonseed meal possesses far greater feeding value than cottonseed and can be used to advantage where cottonseed cannot. The experiment station will gladly calculate rations and suggest methods of feeding for Oklahoma farmers who will write and state the kind of animals to be fed and the market prices of available feeds. Sometimes it is more profitable to feed cottonseed than cottonseed meal but often, when all of the facts are known and understood, the reverse is true. (November, 1902.)

FEEDING EXPERIMENTS.

In the fall of 1899 the Oklahoma Agricultural Experiment Station began a series of feeding experiments to ascertain the comparative feeding value of corn meal, Kafir meal, alfalfa hay, and Kafir stover as beef producers. In these experiments, all feed has been weighed in and sampled for analysis and all refuse has been weighed back and likewise sampled. Lots of five steers each have been used for testing the rations. The steers have been weighed at stated intervals and any happenings or conditions that might have a bearing on the results have been noted.

The third experiment of the series has been carried out during the past winter and was closed March 3. Up to this time these experiments have been reported only briefly in press bulletins but soon the detailed account of the three years' experiments will be given in a regular bulletin.

The following is a brief summary of the work for the past winter. On October 14, at the beginning of the experiment, the twenty steers used averaged 1014 pounds. They were a fair quality of native cattle raised in the neighborhood of the station. Most of them showed a good proportion of Shorthorn blood and their ages were not far from thirty months at the beginning of the experiment. They were taken from the prairie pasture and put into the feed lots several weeks before they were divided into lots for the experiment.

The feeding continued for 150 days. The following gives the feed given to the different lots, the gains, and the feed required to produce a pound of gain:

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Lot 1; fed corn meal and alfalfa hay; gained 1677 lbs. or an average daily gain per steer of 2.39 lbs. Each pound of gain required 7 lbs. of grain and 5.99 lbs. of alfalfa hay.

Lot 2; fed Kafir meal and alfalfa hay; gained 1654 lbs. or an average daily gain per steer of 2.36 lbs. Each pound of gain required 7.35 lbs. of grain and 6.52 lbs. of alfalfa hay.

Lot 3; fed corn meal and Kafir stover; gained 1508 lbs. or an average daily gain per steer of 2.15 lbs. Each pound of gain required 8.23 lbs. of grain and 7.07 lbs. of Kafir stover.

Lot 4; fed Kafir meal and Kafir stover; gained 1197 lbs. or an average daily gain per steer of 1.71 lbs. Each pound of gain required 10.35 lbs. of grain and 8.92 lbs. of Kafir stover.

Each lot of steers was followed by three hogs that were given a light grain ration in addition to what they obtained from the manure. The three hogs in each lot gained as follows: Lot 1, 336 lbs.; Lot 2, 394 lbs. Lot 3, 416 lbs.; Lot 4, 416 lbs.; Lot 5, 224 lbs.

Charging the corn meal at 85 cents and the Kafir meal at 70 cents per 100 lbs. and the alfalfa hay at $10 and the Kafir stover at $4 per ton, the total feed of the lots of steers cost as follows; Lot 1, $150.09; Lot 2, $139.05; Lot 3, $126.85; Lot 4, $108.05.

At the same time that the above lots of steers were being fed, an extra lot of five steers was fattened on a grain ration consisting of three-fifths corn meal, one-fifth cottonseed meal, and one-fifth cottonseed. They were also fed 3 lbs. of prairie hay per head per day and all of the oat straw they would eat. The results obtained are interesting but are not strictly comparable with those from the other lots as the steers from this odd lot were about 200 lbs. lighter to begin with and were not of the same quality as the steers in the other lots.

This Lot 5 gained 1626 lbs. in the 150 days, or an average daily gain per steer of 2.32 lbs. Each pound of gain required 6.86 lbs. of grain and 4.6 lbs. of roughage. Figuring the cottonseed at 65 cents and the cottonseed meal at $1.25 per 100 lbs., the prairie hay at $8 and the oat straw at $6 per ton, the feed of this lot cost $118.22.

The steers and hogs were loaded March 8th and sold on the Kansas City market March 9, 1903. The hogs were sold in one bunch at $7.20 per 100 lbs. The steers were divided into lots as they were fed at the station and each lot was sold on its merits.

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Following are the results per lot:

	K. C. Weight	Price	Shrinkage	Dressed Out
Lot 1—	6500	4.70	251	59.5
Lot 2—	6460	4.85	231	60.3
Lot 3—	6340	4.65	213	58.4
Lot 4—	6110	4.50	221	56.9
Lot 5—	5830	4.55	135	57.9

The freight on the steers to Kansas City was 31 cents per 100 lbs. In addition to this, the expense of yardage, hay, and commission per lot of five steers was $3.95. On comparison of the net returns of the steers with the first cost of the steers at three cents per pound and the cost of the feed as stated, the loss per lot was as follows: Lot 1, $20.92; Lot 2, $0.82; Lot 3, $6.99: Lot 4, $10.01; Lot 5, $14.12. Taking five cents a pound as the cost of the stock hogs at the beginning of the experiment, counting all as selling at $7.20 per 100 lbs. in Kansas City, figuring a fifteen pound shrinkage per hog from the station weights, charging each lot with 1095 lbs of corn meal fed each lot while with the steers, and deducting the shipping expenses (freight forty cents per hundred pounds,) the net return for each lot of hogs is as follows: Lot 1, $19.34; Lot 2, $23.10; Lot 3, $24.78; Lot 4, $28.62; Lot 5 $16.01.

Comparing the profits on the hogs with the losses on the steers, and not counting labor, the balances of each lot of five steers and the three hogs stand as follows; Lot 1, loss $1.58; Lot 2, gain $22.28; Lot 3, gain $17.99; Lot 4, gain $18.61; Lot 5, gain $1.89.

These results will be commented upon in the bulletin reporting the results in full which will be issued later. Many other points will be given there which will aid in properly interpreting the results. The wet weather of the past winter made it very unsatisfactory for feeding. In previous winters on the same rations, the steers made daily gains of 2.72, 2.73, 2.33, and 2.36 pounds per day per steer while they made only 2.36, 2.39, 1.71 and 2.15 pounds this year fed for the same length of time. (March, 1903.)

A GOOD POND.

The winter season may be very profitably spent in building ponds on farms where there is not an abundant natural water supply. A constant supply of water of good quality is essential to success with live-

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stock and there are but few farms on which the present sources of supply could not be improved. Water for household purposes must be obtained from wells, cisterns, or springs. The last are not common and the water from wells is very variable both in quality and in amount. The experiment station has analyzed waters from wells in practically every part of the territory and while they are usually free from organic contamination, a large proportion of them contain too much dissolved mineral matter to make them either palatable or healthful. Cisterns if properly constructed and looked after, constitute a very desirable source of pure water for drinking and cooking.

Unless there is a natural stream that contains water throughout the year, the source of stock water is either wells or artificial ponds. Where more than a few head of stock are kept and watered from a well, a windmill is almost a necessity and while Oklahoma has the reputation of being a very windy country, there are many days and even weeks at a time when windmills do not turn. If a windmill is depended upon, there must be a storage tank of sufficient size to hold a supply for calm periods. Thus the outfit must consist of a well, a pump, windmill, and storage tank if this plan of securing stock water is resorted to. The cost of this will vary from one hundred to three hundred dollars and the outfit requires constant attention to keep it in good working order.

Thousands of ponds have been built as sources of stock water but very few of these ponds have been properly made. Water for any use about the farm should be as clean and pure as it is possible to make it. Pond water at best is not ideal but the average pond is constructed with every facility for the making of the water of the pond the worst possible. Cattle and hogs stand and wallow in it, them drink of it or refuse to do so and go without water. Then they become sick for some "unaccountable reason" when there was plenty of water in the pond. Too often, the pond gets the drainage of the barnyard, being located solely with reference to proximity and with no regard to the kind of water that will flow into it.

A pond which is to furnish water for stock should be located so as to receive its water from native prairie hay land; if this is not possible, then from native prairie grass pasture. More water will run off from such land than from cultivated fields, it will be cleaner, and will not carry with it so much sediment that will in time fill the pond. The pond should be fenced so that no animal can get into it and if any fence

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on the farm is kept in perfect repair, it should be the fence around the pond. A galvanized iron pipe should be laid through the dam at such a point that it will completely drain the pond and the end of the pipe inside of the pond should be staked up out of the mud and be provided with a fine strainer. A cut-off may be placed either inside or just outside of the pond bank and the pipe should be at least a foot below the surface of the soil where it comes out of the bank. Nearly everyone knows how to build a pond bank. The chief cause of leaky ponds is failure to remove the sod where the bank is to be. The sod in time rots and causes leaks. On some sandy soils, the hauling of clay may be desirable but this is seldom necessary.

Up to this point, the cost of the construction of the pond, where the ordinary natural advantages exist, will be about the same as digging a well. If the pond is in a pasture, a galvanized iron stock tank with an automatic float valve should be connected with the pipe just below the pond bank. If water is wanted at other places on the farm, it may be piped if sufficient fall can be secured and this should be taken into consideration when locating the pond.

Such a pond as this, with a capacity of about one million gallons and full of water now, may be seen on the experiment station farm. It is on a hill in the pasture and gets its water from sod land above it. Water is piped to all of the feed lots, including the hog pasture lots, and flows by gravity to the second floor of the barn. As it runs from the faucets, it is as clear as the average well water and it tastes good. The cost of building the pond and of piping the water for about one-third of a mile was about four hundred dollars. Barring unusual accidents, it should cost nothing for repairs and it doesn't cost a cent to operate. It is possible that in time, the pipes may become clogged with sediment, the fall being so slight that the water does not go through the pipes with sufficient force to keep them clean. But if taken in time when first incations of trouble are noticed, and water is forced through with a force pump, the job of cleaning the pipes will be a small one. This will in all probability not occur in several years.

There are few farms where a pond could not be constructed in the same manner and but few cases where so much piping will be required. Ponds built during the early winter have time to settle and the spring rains will fill them and insure a supply of water throughout the summer. But it does not pay to neglect reasonable precautions and the expenditure of a little money in providing good water is economy of the best sort. (December, 1902.)

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A DANGEROUS FRAUD.

While traveling in Woodward county investigating the loco disease of cattle the Veterinarian of the experiment station procured from a stockman a sample of a sure cure for black leg in cattle which he had obtained from a traveling "veterinarian." The material was analyzed and found to be corrosive sublimate, a very poisonous chemical, which is dangerous to have around at any time and doubly so when in the guise of a mysterious cure for a disease. The stockman in this case knew that the only treatment for black leg was preventive vaccination with vaccine properly prepared and procured from reliable sources. It is of course impossible to estimate the damage caused by irresponsible persons of which this "veterinarian" is a type. The experiment station makes every effort to acquaint Oklahoma farmers with new things that may be of benefit to them and an inquiry in doubtful cases will always bring a prompt reply giving the facts in so far as the station can determine them. The mysterious is always to be distrusted. (August, 1902.)

ANOTHER FRAUD.

The experiment station received the following communication from a Pawnee County farmer on May 6, 1903.

"When at Pawnee a few days ago, I met a man who was selling farm rights for a preparation which he claimed would destroy borers when put on trees and would clear an orchard of gophers when buried in the orchard. He said that the experiment station had offered him $3,000 for a half interest in his patent. Is the whole matter a fraud and a lie or not?"

It is. The station knows nothing of such a preparation, has made no offers for interests in patents of any sort, and warns farmers against expending their money for this and other varieties of "blue sky." It is impossible to follow all of the fakes which are hatched up for the purpose of getting the farmers' money, but the station is always ready to place any information which it possesses at the disposal of farmers and others who request it. (May, 1903.)

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EXPERIMENT STATION REPORT.

The eleventh annual report of the Oklahoma experiment station, for the fiscal year ended June 30, 1902, has been sent to the addresses on the station mailing list. The report contains a statement of the work of the A. and M. College and of the experiment station, and popular articles on the following subjects: wheat experiments; selection of cottonseed; pasturing wheat; broomcorn; Bermuda grass; rape for early spring feed; alfalfa in Oklahoma; feeding wheat; stock feeding; wheat meal, bran and shorts; rations for fattening steers; feeding cottonseed products to steers; feeding cottonseed meal to hogs; fruit trees; spray apple trees; cultivate trees; fall planting of trees; plant trees and care for them; blackberries in Oklahoma; potato growing; animal parasites; vaccination to prevent blackleg; loco investigations; wooly aphis; borers in soft maples; and protection against plant diseases and insects.

The report also contains a table showing the annual rain fall at different places in Oklahoma, compiled from the records of the U. S. weather bureau. All of the publications are sent without charge to citizens of Oklahoma. The station mailing list contains over 18,000 names. Many have changed their addresses and failed to notify the station. When publications are returned undelivered the name is erased from the list.

All Oklahoma and Indian Territory farmers should see to it that their names are on the list so that they may receive the station publications and derive whatever of benefit there is to be had from the experiments which are made. (September, 1902.)

VISIT THE EXPERIMENT STATION.

It should be understood by farmers generally that they are always welcome visitors at the experiment station. While the results of the experiments made by the station are published and widely distributed, a personal consultation with the station officers is always desirable. Many little points about the experiments cannot be brought out in bulletins or by correspondence and the members of the station staff are glad to explain these to interested persons. The station also derives benefit from these visits because they bring the workers in contact with actual farm conditions and with the problems in which farmers are interested. The usual short course in agriculture, horticulture, and

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mechanic arts will be given by the A. and M. College the coming winter beginning January 6 and continuing for eight weeks. Parents should accompany the boys who will come to take this course and learn at first hand of the facilities for instruction in agriculture which the college has and of the investigations in progress at the experiment station. A circular describing the work of the short course has been issued and will be sent to all who make known their wish to receive it. (October, 1902.)

TEXAS FEVER.

The frequent inquiries received in regard to Texas fever make it necessary to review in a brief way the essential features of the disease as well as the general plan that may be adopted by any one to prevent the disease, or to stop it, if it has already appeared.

There are a few people who doubt the "tick theory" of Texas fever. For the benefit of the few it may be said that there is no disease of either man or animals more thoroughly worked out or better understood than Texas fever of cattle. The Bureau of Animal Industry began working on this question in 1889, and the results of a great many experiments proved that the tick carried the disease to susceptible animals. Since this time every experiment station, where the question was of any importance, has done work along similar lines and always with the same results—that the tick is the means of transmitting the disease.

No one ever saw an outbreak of Texas fever without the presence of ticks. The old theories in regard to Texas fever have been completely disproven. The idea that southern cattle with sore feet or that saliva from these cattle was the means of spreading the disease has been entirely disproven. At one time some claimed that bacteria were the cause of the disease but all of these theories have been disproven by experimenting with the tick. The fever can be given to susceptible cattle by placing young ticks on them or the disease can be transmitted by inoculating cattle with blood from a southern animal. After cattle have become infected with the disease the infection remains in the blood for an indefinite length of time, probably during the life of the animal.

While the tick is the carrier of the disease the fever is caused by a small organism that is introduced into the animal by the tick. This small organism, which is the actual cause of the disease processes in the

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animal, lives in and destroys the blood corpusles. This action on the blood is the cause of the extreme weakness of the sick animal as well as the noticeable changes seen in the post mortem examination of Texas fever cases. The disease affects the blood more than any other part of the body.

Recently some ticks that had been secured from cattle that had the fever were brought to the veterinary laboratory. These ticks were placed in the laboratory and began laying eggs in two days and in twenty days after the first eggs were laid young ticks were hatching out. These young ticks hatched in the laboratory are capable of giving Texas fever to cattle that are not accustomed to ticks. Such an experiment has been made so often that there is no question as to what the results will be.

There have been many inquiries in regard to Texas fever from the Kiowa and Comanche country since its settlement. Many cattle were taken from western Oklahoma and other localities where there was no infection and were brought in contact with infection in the new country. This has resulted in a great many cases of fever. A number have sent ticks to the experiment station to have them identified.

The symptoms of Texas fever are usually characteristic but other conditions may give similar symptoms. When the disease appears among matured cattle there will always be some loss. A post mortem examination will show in a general way the following conditions: The liver is usually enlarged, soft and mottled in appearance; the gall bladder is always filled with a thick granular bile and the spleen is larger than normal, soft and very black. The bladder may contain bloody urine. If the animal lives several days after the fever begins, bloody urine may be passed and the bladder will be found filled with the same material.

While there is no specific remedy for Texas fever in the way of a cure there is no disease so easily stopped or with which one can work with any more assurance of success if it is handled in the right way. If there are no ticks on the cattle there will be no fever and if the disease is among the cattle it will stop as soon as the cattle are thoroughly cleansed of ticks. To counteract the high fever accompanying the disease it is necessary to give something to reduce the fever and keep the bowels open. Salts in one or two pound doses, repeated if necessary, will be effective. Any physic, as raw linseed oil or lard, may be used. Green feed such as corn is good to keep cattle in condition. At

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the first indication of fever the cattle should be given all the green feed they want and everyone gone over carefully to remove all of the ticks. This is where so many fail in handling the disease. The sick animals should be doctored but at the same time the well ones should be gone over and the ticks removed. In this way the disease may be stopped. Any of the oils thoroughly applied will kill the ticks but it must be well applied, especially to the under parts of the body, inside the thighs, sides of the neck and chest. The large ticks may be removed by hand but young ticks are too small to be found among the hair, consequently they must be killed by applying some of the oils.

Information has reached the experiment station that parties in certain localities were going over the country vaccinating cattle to prevent Texas fever. Cattle may be immunized against Texas fever but not by any such process as is practiced by these parties. There is no reliance to be placed in any such treatment and stockmen allowing themselves to be imposed upon in this way are hardly deserving of sympathy when they handle cattle and fail to inform themselves about so common a disease as Texas fever. (August, 1902.)

PINK-EYE.

Pink-eye is one of the common diseases about which the experiment station receives a great many inquiries. Some regard this as a distinct disease, but such is not the case as it is only one of the many forms that influenza may assume. Influenza is regarded as a contagious and infectious fever that usually exists as an epidemic. Pink-eye being a mild form of influenza must also be regarded as a disease that is liable to attack all horses and mules with which it is brought in contact. If pink-eye is not associated with any of the other forms influenza may assume, it is usually a very mild trouble but other organs may become involved to such an extent as to cause death.

As the name indicates pink-eye is a form of influenza where the eyes are swollen and their membranes have a red or pinkish color. Other very noticeable symptoms are that the animal may appear stiff and sore, this condition usually being accompanied by high fever. Frequently there is a certain amount of swelling of the legs and under-surface of the belly.

Local remedies are of very little value in treating this disease as

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they have no effect on the system. The high fever may be controlled by using aconite in twenty drop doses three times daily or by using quinine in dram doses. Small doses of salts and potassium nitrate should be given from the beginning of the disease to keep the bowels and kidneys in perfect order.

Frequent inquiries are received asking for remedies against pink-eye in cattle. This disease does not attack cattle but a very common disease among them and one which resembles the local effect of pink-eye is catarrhal conjunctivitis. This disease is very common and frequently causes loss of sight. Local treatment is very helpful in this disease as it will reduce the inflammation and congestion. For an eye wash use boric acid one dram and pour on this 4 ounces of boiling water, allow to cool and then apply to the eye two or three times daily. (October, 1902.)

REMEDIES FOR BORERS IN TREES.

There are several kinds of borers which work in the trunks of fruit-trees and shade-trees in Oklahoma, as the farmers are learning by costly experience. The most troublesome of these is the flatheaded borer, which is reported to work in apple, pear, quince, plum, peach, cherry, ash, elm, maple, box-elder, and other trees. This borer is especially destructive to newly transplanted trees, and seems to prefer trees of which the bark has been injured by sunburn.

The adult of this insect is a beetle. It lays eggs, probably mostly in April and May, in crevices in the bark of suitable trees, usually on the southwest side. The eggs hatch in a few days, and the young grubs eat their way through the bark and burrow in the wood, sometimes completely girdling the tree. By the next spring the grub has grown to full size. It then bores outward nearly through the bark of the tree, and then undergoes transformation into a pupal stage, corresponding to the chrysalis of a butterfly. After about three weeks in this condition, the adult beetle emerges from the skin or case of the pupa, cuts a hole through the bark, and comes out prepared to do its part in the work of laying more eggs.

Several methods are used to check the work of the borers. The presence of the borers in the trees may be detected by discolorations of the bark, by the exudation of sap or gum, or by the presence of castings beneath the burrow. In such cases, if the burrows be not too deep or

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too long, the borers may be killed with a pointed wire. Otherwise they may be destroyed by cutting them out with a knife, or by pouring kerosene or hot water into the hole.

The best way to combat the borers is by preventing the laying of eggs on the bark of the tree trunks. Wrapping the trunk with newspaper or wrapping paper is one of the easiest and best methods of securing this result and it has the advantage that, besides keeping the female beetles from the bark, the paper protects the bark from the injurious effect of the heat of the sun. Paper used for this purpose should cover the tree trunk completely, and be held in place by twine not strong enough to injure the growing tree. Soil should be drawn up an inch or two around the paper at the foot of the tree, to prevent the female beetles from getting inside the paper from below, and the top of the paper should be made to fit the bark closely. A band of cotton lint just inside the top of the paper will serve to keep the females out from above.

Various washes have been used to prevent the insects from laying their eggs on the bark or to kill the newly hatched grubs before they make their way into the bark, but it is not certain that the use of these will always be found profitable in Oklahoma.

Even more important than protecting the bark of the trees from the egg-laying female beetles, is the matter of keeping the trees in vigorous condition by proper cultivation of the soil. Grass and weeds should not be allowed to take the moisture needed by the trees. After rains the crust of the soil should be broken into a fine mulch to reduce the rate of evaporation from the soil. It is also recommended that trees be headed low, so that the leaves may shade the trunk from the hot midday sun. (April, 1903.)

THE HESSIAN FLY IN OKLAHOMA.

A fly, which is, in all probability, the Hessian fly, is reported to have done considerable damage in some of the wheat fields of Kay county. The entomologist of the experiment station has examined some of the affected fields, and found that nearly all of the maggots of the fly have passed into the stage which is called from its appearance, the "flaxseed." It is expected that they will remain in that stage until after harvest, and not do any further damage to the stalks which are not yet infested with

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the maggots. The recent rains have aided the wheat in sending out new stalks to replace those which were killed or stunted by the parasite.

The fly is a small two-winged gnat, which lays its eggs on the leaves of the wheat. When these hatch the maggots crawl down between the leaf sheath and the stem. They feed on the juices of the plant, and, when they reach full size, became transformed into the "flax-seed" stage which corresponds to the chrysalis of the butterfly. The gnat-like flies emerge from the "flaxseed' puparia in the fall and spring in largest numbers.

One of the methods of checking the fly is by turning the stubble under by deep plowing, and afterwards rolling the field to compact the earth so as to bury any flies that may mature.

All volunteer wheat, rye, or barley should be destroyed, as it is liable to harbor the insects during the summer or early fall. It may be used as a trap and destroyed after the eggs have been deposited on it in the fall.

Rotation of crops is advisable wherever practicable. In some seasons late planting saves the wheat from injury, because it comes up too late for the flies to lay their eggs on it. For southern districts it has been recommended that the planting be done between October 10 to 15. Comparison of fields planted at different dates last fall should show whether any wheat escaped severe attacks by reason of having been planted late. But some of the late planted wheat may have been infested by the brood of flies which emerged in April from neighboring fields which were infested in the fall. (May, 1903.)

BODY-BLIGHT OF PEAR TREES.

This disease works on the trunk and larger limbs of pear trees. It is easily recognized on the trunks of trees that are not old enough to be covered with rough bark. The first appearance of the disease is in the spring when dark sunken spots are seen scattered over the trunk. These spots are round or oval in outline and gradually increase in size until the latter part of the growing season. A distinct boundary line is then formed by the shrinking of the dead tissue. At this time the dead bark can be easily removed in one piece. The inner bark remains sound and suffers but little, if any, the first year. If this dead bark

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is not removed it becomes very dry and hard and in two or three years forms such a heavy layer of dead bark that the trees become bark-bound. If this condition is not removed the tree stops growing and dies.

The dead bark should be removed as soon as found. The trees should be gone over in the spring about the time growth starts and all diseased bark removed. Tree washes and fungicides seem to have no value either in preventing the disease or checking its spread. Removing the diseased bark and thoroughly cleaning the trunk and larger limbs seem to be a sure and efficient remedy. (September, 1902.)

GRAPE VINE LEAF-HOPPER.

The grape vine leaf-hopper or thrip has done a great deal of damage to a great many vineyards of Oklahoma the past summer. This insect does harm by sucking the juice of the plant and works on the underside of the leaves. No satisfactory method of destroying this insect has been discovered. The following are two of the best methods that have been tried: Mix equal parts of sulphur and fresh lime and dust the vines thoroughly, being sure to reach the underside of the leaves. This can be applied as often as the appearance of insect makes necessary. In the other method the vines are sprayed with water to wet the under side of the leaves and then pyrethrum powder is dusted on the wet leaves and vines. Neither of these methods is of much value unless the work is done very thoroughly.

These insects are blowed about very badly by the wind and will do less damage if the vines are on a high trellis and the rows run north and south. At the experiment station, vines of some varieties on high trellises showed very little or no effect of the attacks of the insects, while vines of the same variety on low trellises were very badly damaged. Agawam, Niagara, Green Mountain, Goethe, and Lady Washington were very badly damaged on high trellis. The following varieties suffered but little on high trellis: Elvira, Catawba, Concord, Cottage, Delaware, Early Ohio, Herbemont, Herman Jaeger, Moore's Diamond, Moore's Early, Norton, and Telegraph. (December, 1902.)

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REMEDIES FOR THE MELON LOUSE.

The melon growers of Oklahoma all know what a serious pest the melon louse has been in the territory. And most of them who do not already know of the fact will be glad to learn that we have reports of the successful use of remedies against this pest in some of the states. To such as have not found a solution of this problem we make the recommendation that they give one or more of these remedies a fair trial during the coming season. To do this, preparations for destroying the bugs must be made before the melon seeds are planted. This is because the only successful destruction of the lice must be done very soon after they make their first appearance on the young vines. Therefore, to insure success, if that be possible, the method of killing the bugs should be chosen now, and all the necessary materials and appliances should be procured at the earliest possible date.

No preventive measures which may contribute to success should be neglected. The most important of these is the clearing up and burning of rubbish and weeds in and around fields which have previously been infested with the melon louse. The best time to destroy infested vines is the moment they are regarded as being of no further use. Too much in the way of results should not be expected from the destruction of infested vines and weeds, for the melon louse lives on many other plants, for example, the cotton, and there are many sources from which the insects may come to the melon vines.

The young vines should be carefully examined from day to day for the first appearance of the lice, and the work of destroying them should begin as soon as they are found. It has been observed that in some fields they make their attack at first on only a few vines, and then spread from these over the whole field. In such cases the advantage of early destruction is plain to all. Another reason for promptness is the fact that the vines are more easily treated for the bugs when they are small, and still another reason is, that if the leaves become curled it is difficult, if not impossible, to make a thorough application of a spray to the underside of the leaves, where most of the lice are located. And it is to be remembered that the insects multiply with very great rapidity.

The principal means used for killing plant lice on melon vines and other plants are spraying with tobacco decoction or kerosene emulsion, and fumigating with tobacco or carbon bisulfid (hokey pokey.) Whatever remedy is chosen, it should first be tried on a few of the

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infested plants to test its efficiency. When it is certain that it kills most of the insects but does not injure the vines, it is to be applied to all of the affected vines. It is a good plan to make a second application of most remedies, and to do this soon, so as to prevent a large increase of bugs from such as have escaped the first operation.

Spraying with a tobacco decoction is recommended as a remedy least likely to injure the vines. This is to be done with a spray pump and a nozzle which will throw the spray on the underside of the leaves of the infested plants. The tobacco decoction used should be prepared in such a way that it may always be duplicated by a decoction of about the same strength. One of the easiest ways to secure this result is to make it by adding a commercial extract of tabacco to water in a definite proportion. The "Rose Leaf" extract of tobacco sold by dealers in seeds has been used as a spray for the melon louse by adding it to water at the rate of three tablespoonfulls of "Rose Leaf" extract of tobacco to one gallon of water.

Two gallons of hot water poured on one pound of good tobacco stems in a wooden pail and allowed to stand over night or longer gives a tobacco decoction that has been used with good results, but this decoction varies in strength with the quality of the tobacco stems. There are other preparations of nicotine on the market which may be used in making the decoction for the spray. In whatever way the spray be prepared its effect on the vines and insects should be tested before it is applied to any large number of plants, and sufficient time should elapse after the test spraying for the plants to show any injury which the spray may cause, and for the insects to revive if they have been stupefied instead of killed. As soon as it is certain that the spray kills the bugs without injuring the plants it should be applied thoroughly to the vines and especially to the lower sides of the leaves of all the affected plants. It may be well to repeat the spraying once or twice after a few days, so that any insects which escape the first spraying may be caught the next time. Though such insects may be too few to be noticed at first, they may multiply rapidly under favorable conditions.

When diluted kerosene emulsion is used as a spray against the melon louse, care should be taken to test the effect of the emulsion on the plants, before applying it to the whole crop. Then, if it be found too weak for the bugs or too strong for the vines, it may be made weaker or stronger as required. A formula recommended for the preparation of an emulsion for plant lice is as follows:

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1-2 lb. soap (whaleoil if possible),
1 gal. water
2 gals. kerosene.

For use against the melon louse add one gallon of the above emulsion to nine gallons of water. To be effective this must be sprayed so as to reach the entire lower surface of the leaves of the plants.

The simplest way to use tobacco for fumigation of the melon louse is to burn half an inch of "nikoteen punk" under a tight box or tube placed over the young vines and pressed into the soil. When this is done the box should be left over the vines long enough for the insects to be killed. In treating a large field enough boxes may be used so that by the time a man has put all the boxes in place it is time to change the first box to another plant. This remedy should also be tested to determine what is the best amount of punk and the proper length of time with the size of box used.

Treating the melon louse with the fumes of carbon bisulfid (hokey pokey) is a comparatively simple operation but has the disadvantage that unless it is done with care not to use too large a dose or expose the plants too long to it, it may injure the vines. Two tablespoonfuls poured into a saucer or a pan and placed beside the plant to evaporate, the whole to be covered immediately with a tight box pressed into the soil and allowed to remain in that position for an hour and a half, has been found to do the work of killing the insects. In making the test of this method before applying it to the field it will be well to see that the test is made with the temperature as high as it is likely to be in practice. (February, 1903.)

THE STRIPED CUCUMBER BEETLE ON MELON VINES.

It is reported that the striped cucumber beetle was one of the causes of damage to the Oklahoma melon crop last summer. In localities where such was the case, early preparations should be made for disposing of this insect during this season.

In addition to the preventive measures of cleaning up rubbish and a thorough cultivation of the melon ground, the use of Bordeaux mixture as a repellant, and squash as a trap crop are among the most promis-

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ing of the remedies recommended by those who have successfully dealt with this insect.

Squashes are planted about four days before the melons. One or more rows of squashes should be planted, according to the size of the field. Some of the trap plants may be dusted with Paris green when the beetles gather on them. Others should be left to attract the beetles through the summer.

It seems that spraying the young melon vines with Bordeaux mixture not only repels the cucumber beetle, but also poisons some of the insects which feed on the sprayed leaves. (March, 1903.)

PICK THE BAG-WORMS FROM THE TREES.

On many fruit-trees and shade-trees one may find the cocoons of bag-worms. They are usually from one to two inches long, and are suspended by one of the pointed ends from the smaller branches of the trees. Each of the larger cocoons contains, during the winter, a large number of eggs. If these are allowed to remain on the tree until the eggs hatch in the spring, there will be produced from the eggs in a few cocoons enough young worms to strip all the leaves from a tree early in the summer.

These worms seem to be especially fond of cedar trees, and are very likely to be overlooked on these trees until they have become so numerous as to seriously damage the trees. With these worms a stitch in time saves ninety. The cocoons picked from the trees should be thoroughly destroyed. Should it become necessary to destroy large numbers of the worms in the summer, a good plan would be to dust or spray the trees with Paris green, London purple or some other arsenical poison.

One of the larger cocoons left on a marked limb of a small tree should afford a crop of worms which would afford interesting and instructive object lessons to boys and girls, and older folks. This crop of worms should be thinned from time to time, and when the worms retire into the cocoons to pupate, the twigs from which they hang may be placed in covered glass jars. The male moths emerge as winged adults, but the female moths remain in the cocoons. (March, 1903.)

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REMEDIES FOR THE CHINCH BUG.

It is generally recognized that the most effective remedies against the chinch bug are trap crops and barriers, combined with mechanical means of destruction.

A good plan is that which places a field of alfalfa, or some other crop which is not attacked by the chinch bug, between wheat and other crops which are attacked by the bugs when the wheat is cut. Where this is impossible or impracticable, rows of cotton may be planted for barriers, and rows of sorghum for traps, between wheat and corn or Kafir. The following diagram shows how these barriers and traps have been successfully used at the experiment station for the destruction of the bugs:

1. Wheat.
2. Drive
3. Castor Beans, 8 rows.
4. Cotton, 8 rows.
5. Sorghum, 4 rows.
6. Cotton, 8 rows
7. Sorghum, 4 rows
8. Cotton, 8 rows
9. Kafir

Immediately after the wheat was cut the ground was plowed. The bugs that escaped crossed 2, 3, and 4, and collected in 5. This was then plowed deeply and rolled hard. The bugs not caught here gathered in 7, which, a few days later, was treated the same as 5. The sorghum was replanted in 5 and 7 four or five days after being plowed under. In this way the crop of Kafir was saved from the bugs.

A dust furrow may be added between 8 and 9 by anyone using this method who finds that the bugs are crossing 8. (March, 1903.)

GINSENG A FAILURE IN OKLAHOMA.

The culture of ginseng was attempted at the experiment station this spring. The plant requires a moist soil and climate and plenty of shade. This season has been as close to that description as an Oklahoma spring is liable to be. The plat selected for the work is on the

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north side of a grove of shade trees and the soil was placed in the very best condition for the crop. Good germinated seeds were planted April 4th, 1902, and in due time a good stand of young plants came up. The bed was mulched and given all the attention and care that could improve the conditions surrounding the plants. On June 25th most of the plants showed lack of vigor and on July 22nd all the plants were dead. (August, 1902.)

VINEGAR FROM WIND-FALL APPLES.

Apple trees in Oklahoma set very full of fruit this year and now the ground under the trees is almost covered with wind-fall apples. Most of this fruit will lie on the ground and rot and breed a good crop of apple worms for next year. These wind-fall apples will make good vinegar if gathered up and run through a cider mill and then the juice thus obtained allowed to ferment. The riper the apples the stronger the vinegar they will make. If the apples are very green a little sugar added to the cider before fermentation sets in will improve the quality of the vinegar very much. The cider should be placed in wooden or earthen vessels and set in the sun until fermentation has run its course. It then can be stored in the cellar or other convenient place for use.

Wind-fall apples in the experiment station orchard were gathered July 31 and made into cider. These apples made an average of two and one-half gallons of cider to the bushel. In 30 days the cider had finished fermentation and was a vinegar of fair quality. Ripe peaches were gathered on the same date and the juice pressed from them and placed in jars for fermenting. In thirty days this was a vinegar of a better quality than could be found on the local market. (September, 1902.)

PLANTING SEED OF FOREST TREES.

How to collect and plant tree seed is a question that is interesting great many farmers in Oklahoma. The planting of trees for shade, ind-breaks, fire wood, posts and fencing material is becoming quite ommon in the prairie districts. The trees desired for such planting an hardly be purchased of nurseries but can be raised on the farm at a easonable cost. Most of the trees used for this kind of plantings bear

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seed while quite young and the small plantings that were made early in the old part of Oklahoma are now bearing seed enough to supply the farms with plenty of young trees. The black locust and catalpa bear young and the seed is easily gathered. The elms do not bear so young as the two trees just named but by selecting the seed from the native white elm that grows along the banks of the small streams most farmers can secure plenty of seed at small cost. The box elder, ash and hackberry are all native trees and the seed can be secured with little trouble.

Tree seeds should be gathered as soon as ripe. The squirrels, mice, and worms soon destroy a large part of the seed if it falls to the ground and some kinds of seeds will not grow well if thoroughly dried. Most of the seeds are easier to gather from the trees than from the ground several weeks after they have fallen. The seeds that mature before midsummer should be gathered and planted as soon as ripe, as few of them will grow if kept till the next spring before planting. The late maturing seeds may be stored over winter and planted in the spring. The seeds with soft shells or coverings should be stored in a cool, dry place. The nuts and seeds with hard dry coverings should be planted in the fall or stored in boxes, sand, or moist soil out of doors. Freezing and thawing these seeds during winter helps to break the shell.

Hard shelled seed may be planted in the fall or early winter if the land is well drained but if planted on wet land they are liable to rot. Moles and field mice will sometimes dig out some of the seed but if the land is free of grass and litter little harm will be done. This will save the trouble of storing and the planting can be done when there is less press of labor by the regular farm work. The seeds should be covered with about two or three inches of soil. If the seeds are stored dry over winter they should be soaked in water for two or three days before planting. Pouring hot water over the seeds will help to soften the shells. The light, soft-shelled seed like the catalpa should be planted in early spring and should not be planted any deeper than is necessary to place them in moist soil.

The soil should be well prepared and should contain a good supply of decaying vegetable matter which may be supplied in form of well rotted manure. The seed of slow growing trees like pines and cedars should be planted in a seed bed where they can be shaded during the first one or two summers. The seeds that are planted in mid-summer may also be planted in a bed and then the little trees can be set in the nursery row the following winter. The seeds that are planted in the

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beds should be planted in rows about eighteen inches apart and thick enough to have the plants about two inches apart in the row. These seedlings require very close attention and good care to bring them through the first summer.

The seeds of the more rapidly growing trees may be planted in nursery rows and the young plants cultivated there until large enough to set in the permanent planting. The seeds should be drilled in the rows so the plants will stand from four to eight inches apart in the row and the rows about three feet apart. The trees in the nursery row must be well cultivated and cared for. (November, 1902.)

THE PEACH CROP.

Peaches have been a full crop in 1902 in all parts of Oklahoma. The trees set full and the season was favorable for the full development of the crop. Good prices were received for all marketable fruit. Most of the trees were overloaded and the fruit was generally small. Most of the peaches marketed were Elbertas, in fact there were more of this variety than all others combined. The general failure of the crop east and north of Oklahoma left a good market and many small peaches sold at a good price that would otherwise have rotted in the orchard. The peaches were smaller than usual but the prices were generally good and the season has been a profitable one for the peach growers. Conditions will not always be so favorable and better peaches must be grown by most of the orchardists if the profits are to continue.

The conditions under which this crop has been produced will in part account for the size of the fruit. The preceding summer and winter were very dry and the trees started into growth last spring in poor condition; many trees died after making a weak start. Good rains came early in the season and the continued wet spell prevented cultivation in many orchards. The weeds and grass got a good start and held their advantage throughout the season in most orchards. During the summer the regular drouth got in its work and with the help of the weeds and grass took most of the moisture and the trees could not grow large fruit and live.

There are three things that the orchardists can do to help the trees mature a crop of large fruit and only one of these things has been

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partially carried out in most of the orchards now fruiting in this country. The first is a thorough system of cultivation. The land should be well plowed in the spring and then given clean, shallow cultivation until the fruit is gathered. The land should then be planted to cow peas or some other crop that will make a good covering of manure to be turned under in the spring. The land must be kept in good condition and furnish plenty of food for the trees, and this can be done only by good cultivation and manuring. The addition of manure to the soil keeps up the fertility and helps to retain the moisture during the dry season.

The trees should be pruned each year. The work should be done in the winter and can then be done with little expense. The strong terminal shoots should be cut back and the top of the trees thinned and about one-half of last year's growth removed. The fruit is borne on the last season's growth and if this is kept in mind the pruning can do a great deal towards thinning the fruit. Cutting back the long terminal branches will keep the tree low and full of live, bearing wood. Better fruit will be borne on the new wood and it is also within easy reach of the pickers. It should be kept in mind that the trees are grown for fruit and not for wood and everything should be done that will make them use their strength in the production of first class fruit. Pruning is one of the necessary operations in peach growing and there is little danger of its being overdone.

Thinning is the third operation that would be of great benefit to the crop. This has not been practiced to any extent in Oklahoma and the fruit has always been undersized for the want of it. The pruning if well done will do much to thin the fruit but it will not complete the work. The fruit on most of the trees should be thinned to six inches between the fruits. If the land is well cultivated, the trees well pruned, and the fruit thinned, the quality and size of the fruit will be greatly improved and the amount of culls reduced to the minimum. All the wormy and blemished fruit can be removed when the thinning is done. The thinning should be done as soon as the fruit is one-fourth to one-half inch in diameter. This is a tedious process and comes with the rush of other farm work but the improved condition of the crop will pay good wages for the work. (October, 1902.)

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FRUIT VARIETIES.

Every farm should have an orchard and a vineyard as one of its permanent improvements. The majority of the farmers will not want to grow fruit for market but everyone enjoys the juicy apple, peach, pear, plum, cherry, and grape and should set about to have them of his own growing. A great many farmers in Oklahoma now grow more fruit than they can use at home and many others in the newer parts of the country are asking what varieties to plant to be most successful.

It is the best plan to buy trees in the fall of some nearby nursery that the buyer can visit and buy the trees on the ground. This will save the expense of freight and enable the buyer to get the trees home in first class condition. Trees transported long distances will usually live and do quite as well as locally grown trees if they are properly packed for shipment and delivered in good condition. If trees of a desired variety cannot be obtained of reliable nurserymen it is often a good plan to buy good thrifty stock of some other variety and then the following year bud or graft on the desired variety.

The buyer should not always buy the cheapest trees. A good tree is worth more than a poor one and the difference in their value will grow greater as the trees grow older. Good trees are the best and cheapest for all purposes and should always be used if they can be obtained. Exhorbitant prices do not insure good trees and should not be paid. The variety of fruit that is claimed to be entirely new and the equal of which has never been known is out of place on the average farm. A strange characteristic of such varieties is that they originate in some other part of the country and there is no orchard near in which this wonderful variety is bearing to prove its merits.

The buyer should take only trees that are thrifty, well grown, and free from blemishes and indications of insects and diseases. The tree should present the characteristic of the variety to which it belongs. It should be well branched, wood firm, and buds well developed. The budded and grafted trees should always be used for fruit bearing in preference to the seedlings. The best and most hardy varieties of the budded and grafted trees are just as hardy and produce just as large and regular crops of fruit as the seedling trees. The opinion that the seedling trees are more hardy and more sure to bear full and regular crops is based upon a comparison of the seedlings, that have been selected for several generations for these very qualities, with the budded

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varieties that are poorly adapted to this climate. The stone fruits are usually budded and the apple, pear, and quince are usually grafted. There is little difference in the value of the piece and whole root grafted trees. Experienced orchardists usually prefer the piece root trees. The manner in which the graft is set, the trees grown and cared for, has more influence over their value than the fact of their being started from a whole or piece root graft.

The subject of choice of varieties is the one upon which most questions are asked and one upon which the least satisfactory advice can be given. The choice of varieties brings in so many likes and dislikes that in the end the orchardist must and does choose his own varieties. The orchardist should first study his soil, his location, and his surroundings. This will enable him to tell what classes of trees and fruit will be best suited to his location. With this information in hand he is able to select the varieties that suit him. He should not covet a variety simply because it was a favorite in an old orchard in another state, but take those that are doing well in his own locality.

Reports have been received telling of success in growing fruit on almost every kind of soil and sort of location. The trees and vines set on bottom land have usually made the best growth due mostly to the difference in the character of the soil rather than location. The trees set on the upland have usually come into bearing earlier and have fruited more regularly than those on lower land. Fruits subject to injury from late frosts have given the best results when set on high or sloping ground. Orchards protected by natural or artificial windbreaks have suffered less from drouth and storms than orchards more exposed. A natural forest is an ideal windbreak but if this cannot be had then a plantation of such trees as locust, catalpa, elm, mulberry, and even seedling peach trees should be provided.

Fruit trees may be set any time during the winter from the first of November till the middle of March. The condition of the soil and the weather at the time the trees are set is of the greatest importance. If the soil is in good condition and the weather not too dry when the trees are set and the work is done well little difficulty will be had in getting the trees to grow. Trees should be set at about the same depth or a little deeper than they were in the nursery row. Set them far enough apart so there will be room for the cultivator and sprayer when the trees are full grown. These operations must be continued as long as the orchard is expected to bear fruit. The following distances are

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about the best on the average land in Oklahoma where the trees are allowed to grow their full size: Apples 30 to 35 feet each way. Cherries, standard pears, apricots, peaches, and nectarines 20 to 25 feet. Dwarf pears and quinces 16 feet. Plums 20 feet. Mixed planting can be used to good advantage in saving land and labor but if good care and cultivation are not given and the thinning not done at the proper time it will result in more loss than gain.

Young trees may be protected from rabbits by wrapping the trunks with corn stalks or other dry material. This wrapping will be of great benefit as a protection against borers if left in place during the summer. Washing the trees with blood to protect them from rabbits is cheap and in many cases has proven entirely satisfactory. Soft soap is one of the best summer washes for young trees. Good clean cultivation stands at the head of the list of preventives for borers. Supplement this by going over the trees two or three times during the summer and removing every borer found. This is the best and only sure method of protecting the trees from borers.

No one should put out an orchard or vineyard if he does not expect to give it as much care and attention as any other crop on the farm. It may be safely said that no orchard will give profitable returns without clean cultivation. Trees require moisture and lots of it, and they get this moisture from the soil. If any other crop grows in the orchard it uses up the moisture that should go to the trees. Frequent clean cultivation for the purpose of keeping the surface soil loose is necessary for success.

After the orchard is planted an occasional manuring will be of great benefit. The organic amtter that is thus worked into the soil improves its capacity for absorbing and holding moisture and the effect of the plant-food will be shown in the thrifty growth of the trees. The soil should be in good condition and as free from all weeds and grass as it is possible to have it. It is a loss of time and money to set trees on land that is not in a good state of cultivation.

What variety of apples, peaches, pears, etc. is best adapted to this climate has been the greatest question that the fruit grower has had to answer in this country. The search for the answer to this question began with the planting of the first orchard and will be continued as long as there are new orchards set. There are now a great many orchards in bearing and a great deal has been learned about the relative value of the different varieties. In 1902 trees of all the following varieties of ap-

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ples fruited in different parts of the territory, Arkansas Black, Bailey Sweet, Baldwin, Bellflower, Ben Davis, Brightwater, Clayton, Cooper's Early White, Dallas, Duchess, Early Harvest, Fallawater, Gano, Grimes' Golden, Jeneton, Jonathan, Late Strawberry, Limber Twig, Lowell, Maiden's Blush, Mammoth Black Twig, Missouri Pippin, Newtown Pippin, Penn. Red Streak, Rambo, Red Astrachan, Red Beitigheimer, Red June, Red Stripe, R. I. Greening, Rock Pippin, Romanite, Roman Stem, Rome Beauty, Shackelford, Shannon Pippin, Smith Cider, Sops of Wine, Stewart's Golden, Summer Queen, Sweet Bough, Sweet June, Tompkins King (King), Wagoner, Wealthy, White Winter Pearmain, Willow Twig, Winesap, Yellow Transparent, and York Imperial.

From all information obtainable concerning the popularity of these different varieties, they rank about as follows: Missouri Pippin, Ben Davis, Winesap, Jonathan, Gano, Maiden's Blush, and York Imperial. There may be many other varieties that do nearly as well as any of the seven varieties just named. Most fruit growers that know the Grimes' Golden say that it merits a place near the head of the list.

For the home orchard the following list is well reported from nearly all places where the varieties have been planted. Ben Davis, Cooper's Early White, Early Harvest, Grimes' Golden, Jonathan, Maiden's Blush, Mammoth Black Twig, Missouri Pippin, Penn. Red Streak, Red June, Red Limber Twig, Romanite, Rome Beauty, Shackelford, Winesap, Yellow Transparent, and York Imperial.

For the commercial orchard the Ben Davis is far the most important variety set. Grimes' Golden, Jonathan, Maiden's Blush, Mammoth Black Twig, Missouri Pippin, Romanite, Shackelford, Wagner, Winesap, Yellow Transparent, and York Imperial are good apples and have qualities that fit them to some degree for commercial planting. Early and mid-season apples can be grown for the market profitably only where the market is near or the transportation facilities are first class.

Pears were not so generally planted at first as the apples and our knowledge of the varieties in this country does not cover as wide a range as with apples. There are, however, a few varieties that have done so well that one need not hesitate to recommned them for general planting. Bartlett, Duchess, Garber, Kieffer, LeConte, and Rutter have proven their worth and are good. Howell, Seckle, Tyson, Wilder Early and Winter Nelis have been well spoken of by different fruit growers and are worth testing.

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There is less definite knowledge of the varieties of peaches than of almost any other fruit. The early orchards consisted mostly of seedlings and the names of what few budded trees that were set have been lost or forgotten. The sale and testing of the budded varieties has been comparatively slow and unsatisfactory. The success with each variety has, to a great extent, been local with exception of Elberta and Alexander. There are about twenty varieties that are well spoken of by fruit growers in different sections of the country, but the reports vary so much that the farmer should visit the orchards of his neighborhood and in that way determine which varieties to set. The most popular variety is Elberta. Alexander, Sneed, Champion, Heath Cling, and Late Crawford are also very commonly planted. The following list is well spoken of and recommended by growers in different parts of the territory: Alexander, Amsden, Champion, Chinese Cling, Crosby, Early Crawford, Early Rivers, Elberta, Foster, Greensboro, Heath Cling, Henrietta, Late Crawford, Mamie Ross, Mountain Rose, O. M. Cling, O. M. Free, Salway, Smock, Stump, and Triumph.

Early Richmond and English Morello are the two leading varieties of cherries. There have been several varieties planted but the two just named have given the most general satisfaction. Ostheim has been planted to a limited extent but promises to be a very good cherry for Oklahoma. Sweet cherries are not adapted to this climate.

Six of the best plums for general planting are Abundance, Arkansas, Burbank, Damson, Golden Beauty, and Wild Goose. There is quite a list of plums that are doing well and are worth planting, the most common of which are contained in the following list: Botan, Forest Garden, Green Gage, Miner, Normand, Pottawatomie, Quaker, Satsuma, Shipper's Pride, Weaver, and Wooten.

There are so many good grapes that it is difficult to select a short list and say that those varieties are the best for general planting. The average farmer does not care to have more than three or four varieties of grapes and many do not care for more than the Concord. The Concord is a good grape for general planting and seems to merit its place at the head of the list. For a wine grape the Herbemont and Hermann Jaeger are the best planted to any extent in Oklahoma. All of the following varieties have been well spoken of by growers and are good grapes: Agawam, Berckmans, Brilliant, Catawba, Concord, Delaware, Goethe, Herbemont, Hermann Jaeger, Moore's Early, Niagara, and Worden.

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The Early Harvest blackberry is the best for general planting. There are other varieties that do well with good care in certain locations, and among the best of these are the Dallas, Kittatinny, Lawton, and Snyder. The same difficulty in naming varieties of blackberries exists as with peaches. To most people there are two kinds of blackberries, the early and the late, and it so happens here that the early variety is the best in the list. (June, 1903.)

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ANNUAL PRECIPITATION (INCHES) OKLAHOMA.

Data furnished by C. M. Strong, Section Director, Oklahoma and Indian Territory Section, Weather Bureau, Oklahoma City.

STATIONS	COUNTY	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902	Average
Ames	Woods								30.97		32.24		28.78			29.00
Arapaho	Custer						21.47	31.08	25.19	26.69	35.64	28.92	29.86	18.23		27.07
Beaver	Beaver								11.84			21.08	16.69	12.35		15.48
Blackburn	Pawnee												47.85	28.60		38.22
Burnett	Pottawatomie				45.84	27.75	25.10	36.17	26.08	33.47	43.20	34.36	29.91	19.12	42.76	33.07
Chandler	Lincoln														46.41	
Clifton	Lincoln						22.29	38.19	19.43	32.69	38.75			22.96	36.19	30.07
Cloud Chief	Washita														39.11	
Ft. Reno	Canadian	31.91	28.79	26.77	33.51	29.40	18.28	22.78	19.18	25.56			37.12	19.18	40.14	28.33
Ft. Sill	Comanche	29.29	31.08	32.76	34.32	24.19	24.08	29.17	17.12	26.29	37.35	46.51	36.47	16.07	46.79	30.89
Guthrie	Logan						22.99	30.69	31.71			32.62	29.88	19.38	42.19	31.92
Hennessey	Kingfisher										37.78	35.19	29.89	19.32	31.58	30.74
Jefferson	Grant						17.69	21.56	26.01	29.70	38.54		27.81		27.82	27.01
Jenkins	Woods										28.26	30.61	28.42	18.92	30.84	27.41
Kingfisher	Kingfisher										39.73	34.45	30.56	26.13	42.55	34.68
Mangum	Greer					11.39	19.52	32.89	22.85	22.49	30.91					28.84
Newkirk	Kay												26.06	28.79	43.96	32.98
Norman	Cleveland							34.78	28.80	31.24			37.11	19.19		29.22
Oklahoma City	Oklahoma			37.43	42.29	24.28	26.72	32.50	21.90	28.47	35.88	43.66	31.45	15.74	41.14	31.79
Pawhuska	Osage Nation										54.24	57.96		24.54	47.24	46.00
Perry	Noble											34.43		24.04	41.11	33.20
Sac and Fox Agency	Lincoln								25.95				35.17	20.80		27.31
Stillwater	Payne									31.38	42.62	32.87	29.98	19.98	40.21	33.84
Taloga	Dewey													17.33	28.37	22.85
Waukomis	Garfield										29.20	31.29	28.81	21.18	33.94	28.88

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FINANCIAL REPORT OF THE OKLAHOMA AGRICULTURAL EXPERIMENT STATION.

FOR THE YEAR ENDED JUNE 30, 1903.

Dr.

To Receipts from the Treasurer of the United States as per appropriation for fiscal year ended June 30, 1903, as per Act of Congress approved March 2, 1887, ... 15000.00

Cr.

By Salaries	1		$6655.00
Labor	2		2500.00
Publication	3		1260.10
Postage and Stationery	4		413.44
Freight and Express	5		245.14
Heat, Light and Water	6		279.46
Chemical Supplies	7		177.63
Seeds, Plants, and Sundry Supplies	8		244.73
Fertilizers	9		33.00
Feeding Stuffs	10		628.80
Library	11		5.90
Tools, Implements and Machinery	12		324.23
Furniture and Fixtures	13		304.59
Scientific Apparatus	14		323.53
Live Stock	15		517.68
Traveling Expenses	16		321.77
Contingent Expenses	17		15.00
Building and Repairs	18		750.00
Total			$15000.00

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SUPPLEMENTARY STATEMENT.

Receipts and Disbursements of Station Sale Fund.

Dr.

To Balance, July 1, 1902	$1233.22
Receipts from Sale of Station Products	2305.60
Total	$3538.82

Cr.

By Labor	$ 490.10
Postage and Stationery	9.24
Heat, Light and Water	21.00
Chemical Supplies	1.05
Seeds, Plants, and Sundry Supplies	39.41
Feeding Stuffs	648.78
Library	63.29
Tools, Implements and Machinery	65.44
Furniture and Fixtures	.75
Scientific Apparatus	1.56
Livestock	123.92
Traveling Expenses	35.50
Contingent Expenses	19.00
Building and Repairs	896.11
Balance	1123.67
Total	$3538.82

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PUBLICATIONS.

A few copies of each of the following publications are still on hand and will be sent in response to requests so long as the supply lasts.

No. 44, Dec. 1899—Field Crops, 1899.

No. 45, Mar. 1900—An Annotated catalogue of the ferns and flowering plants of Oklahoma.

No. 46, May 1900—Digestion trials.

No. 48, Dec. 1900—crop and forage notes, 1900.

No. 49, Feb. 1901—A rhizomorphic root-rot of fruit trees.

No. 50, Apr. 1901—Manuring the soil.

No. 51, Dec. 1901—Feeding cottonseed meal to hogs.

No. 53, June, 1902—Common parasites of domestic animals.

No. 54, June, 1902—The improvement of the castor plant.

No. 55, Dec. 1902—Bermuda grass.

No. 56, Dec. 1902—Garden vegetables.

No. 57, March, 1903—Directions for using vaccine for the prevention of blackleg in cattle.

No. 58, June, 1903—Fattening steers; using cottonseed, cottonseed meal, wheat meal, wheat straw, and hay.

Address all requests to

EXPERIMENT STATION,
Stillwater, Okla

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INDEX.

A PAGE

Advanced Standing 8
Agricultural Course..... 10
Alfalfa in Oklahoma 28-29
Annual Precipitation 65

B

Bag Worms..... 53
Bermuda Grass 30-31
Blue-grass Lawns..... 31-32
Board of Regents 5
Body-blight of Pear Trees 48-49
Borers in Trees 46-47
Buildings 17
Bulletins Issued 16-17
Business Course 8

C

Changes in Courses of Study..... 7
Chinch Bug Remedies 54
Correspondence 18
Cottonseed or Cottonseed Meal..... 34-36
Courses of Instruction 9-12

E

Expense Attending College 14
Experiment Station Report..... 42

F

Farmers' Institutes 18
Feeding Experiments 36-38
Financial Report..... 66-67
Frauds 41
Freshman Class 8
Fruit Varieties..... 59-64

Digitized by Google

G PAGE

General Science Course..... 9
Ginseng a Failure 54-55
Grape Vine Leaf-hopper..... 49

H

Hessian Fly..... 47-48

L

Letter of Transmittal..... 6
Library 13

M

Mailing List 17-18
Manuring Wheat..... 22
Mechanical Engineering Course..... 11
Melon Louse 50-52

O

Oat Crop 27-28
Opening of College..... 14

P

Pasturing Alfalfa..... 29-30
Peach Crop..... 57-58
Peanuts 32-33
Pink-Eye 45-46
Planting tree Seeds..... 55-57
Pond for Stock Water 38-40
Progress of College 7
Publications Available 68

R

Rainfall 65
Report of Director 15-19
Report of President 7-14

S

School of Agriculture and Domestic Economy.....7-8-11
Seed of Forest Trees 55-57
Short Course in Agriculture 12
Station Staff 5, 19
Striped Cucumber Beetle..... 52-53
Sub-Freshman Class 8
Subjects of Investigation..... 15-16
Summary of Press Bulletins..... 20-64

Digitized by Google

T

PAGE

Test the Seeds 33-34
Texas Fever 43-45
Time of Plowing for Wheat 22-23
Time of Seeding Wheat 23-24

U

Use the Stable Manure..... 34

V

Varieties of Fruit 59-64
Varieties of Wheat 20-22
Vinegar from Windfall Apples..... 55
Visitors Welcomed 5
Visit the Experiment Station..... 42

W

Wheat Experiments..... 20-27
Wheat Seeding 24-25
Wheat Varieties 20-22

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OKLAHOMA

AGRICULTURAL AND MECHANICAL

COLLEGE

Agricultural Experiment Station

Thirteenth Annual Report, 1903-1904

Stillwater, Oklahoma

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OKLAHOMA

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OKLAHOMA

AGRICULTURAL AND MECHANICAL

COLLEGE

Agricultural Experiment Station

Thirteenth Annual Report, 1903-1904

Stillwater, Oklahoma

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Oklahoma Agricultural and Mechanical College.

AGRICULTURAL EXPERIMENT STATION.

BOARD OF REGENTS.

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L. L. LEWIS, M. S., D. V. M. ..... Veterinarian
F. C. BURTIS, M. S. ..... Agriculturist
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W. R. SHAW, Ph. D. ..... Botanist and Entomologist
A. G. FORD, B. S. ..... Associate Chemist
L. A. MOORHOUSE, B. S. A. ..... Assistant in Soils and Crops
J. F. NICHOLSON, M. S. ..... Assistant in Bacteriology
F. O. FOSTER, B. S. ..... Assistant in Agriculture
E. H. RILEY, B. Agr. ..... Assistant in Animal Husbandry
W. C. THEILE ..... Clerk and Stenographer

VISITORS ARE CORDIALLY WELCOMED AT ALL TIMES.

The publications of the Station are sent free to residents of Oklahoma and Indian Territories on request. All communications should be addressed, not to individuals or departments, but to the

EXPERIMENT STATION, Stillwater, Oklahoma.

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LETTER OF TRANSMITTAL.

Stillwater, Oklahoma, July 1, 1904.

Sir:—

I submit herewith the thirteenth annual report of the Oklahoma Agricultural Experiment Station, for the fiscal year ended June 30, 1904. In addition to a statement of the work which has been done during the year, and the financial statement as required by law, the report contains several articles on subjects that have a direct bearing on the agricultural interests of the Territory.

Very respectfully,

Governor T. B. Ferguson,
Guthrie, Oklahoma.

John Fields,
Director.

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Oklahoma Agricultural and Mechanical College.

PROGRESS.

The year just closed has been in every way one of the most satisfactory in the history of the institution. There was a slight decrease in attendance, owing to radical changes made in the courses, but the good effect of these changes in the character of work and the standard of scholarship is evident to a gratifying degree. Twenty young men and women were graduated with the degree of Bachelor of Science, and eight others received a certificate showing the successful completion of the business course. The newly organized School of Agriculture and Domestic Economy, arranged for students who are able to attend for only part of the year, surpassed expectations, one hundred and fifteen students having been enrolled in it during the year.

COURSES OF INSTRUCTION.

No material changes have been made in requirements for entrance and in courses of instruction since the issuance of the last report. The preparatory department has been discontinued, though preparatory instruction in the common school branches will be given in the two years' School of Agriculture and Domestic Economy, an analysis of which is given on a subsequent page. All regular collegiate courses cover a period of five years, running through the Sub-Freshman, Freshman, Sophomore, Junior, and Senior classes, and leading to the degree of Bachelor of Science. The courses are as follows:

I.—General Science Course.
II.—Agricultural Course.
III.—Mechanical Engineering Course.

In the General Science course the student may take the general scientific and literary studies which have heretofore been offered in the "General Science and Literature" course or he may take majors in chemistry, botany or zoology, covering exactly the same scope and character of

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work heretofore offered in the courses in chemistry and biology. The Agricultural course and the Mechanical course are specialized and technical courses respectively in agriculture, horticulture and animal husbandry, and in mechanical and electrical engineering.

ADMISSION TO THE SUB-FRESHMAN CLASS.

The sub-freshman class has been established to secure, under competent instruction, a higher degree of efficiency in the studies which underlie the more advanced collegiate work, particularly in English and mathematics. Applicants for this class may be admitted without examination on satisfactory records from the eighth grade of city schools, or on diplomas from the common schools. Not holding these, they must pass a satisfactory examination in the following subjects: Reading, spelling, penmanship, geography, United States History, grammar, and arithmetic. Applicants for this class must be not less than fourteen years of age.

ADMISSION TO FRESHMAN CLASS AND TO ADVANCED STANDING.

Applicants for admission to the freshman class must pass an examination in the studies above mentioned, and in higher arithmetic, algebra to quadratic equations, physiology, physical geography, and general history. Students from high schools who have satisfactorily completed the ninth grade may be admitted on trial without examination. Graduates of approved high schools may be admitted to the sophomore class on their diplomas, without examination.

GENERAL SCIENCE COURSE.

This course is arranged to the end, first, of offering a good general and practical education along scientific and literary lines; second, of giving major work in specific natural sciences, together with an approved amount of instruction in mathematics, literature, language, history, political economy, and other general subjects. Students in this course expecting to specialize in chemistry are advised to take German; all others may take German or Latin.

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THE COURSE IN DETAIL.

[The figures indicate the number of recitation hour per week; figures in parentheses indicate hours of practical work per week.]

SUB-FRESHMAN YEAR

FALL TERM	WINTER TERM	SPRING TERM
Higher Arithmetic.....5	Algebra.....5	Algebra.....5
English.....5	English.....5	English.....5
Physical Geography.....4	Physical Geography (½ term) 4	Physiology.....4
Book-keeping.....5	Physiology (½ term).....4	General History.....5
Spelling and Writing.....(2)	General History.....5	Spelling and Writing.....(2)
	Spelling and Writing.....(2)	

NOTE: After fall and winter terms, students proficient in spelling and writing will take printing.

FRESHMAN YEAR

Rhetoric.....3	Rhetoric.....3	Etymology and Structure...3
German or Latin.....5	German or Latin.....4	German or Latin.....4
Algebra.....4	Algebra.....4	Algebra.....4
Physics.....4	Geometry.....5	Geometry.....5
Sewing—Women.....(4)	Sewing—Women.....(4)	Sewing—Women.....(4)
Freehand Drawing.....(4)	Cooking—Women.....1 (2)	Cooking—Women.....1 (2)
Nursery Work—Men.....1 (2)	Geometrical Drawing—Men.....(3)	Stockjudging—Men.....1 (6)

SOPHOMORE YEAR

Advanced Rhetoric.....2	Theme Work.....2	Theme Work.....2
German or Latin.....4	German or Latin.....4	German or Latin.....3
Geometry.....4	Trigonometry.....4	Trigonometry—Men.....3
Inorganic Chemistry.....3 (4)	Inorganic Chemistry.....3 (4)	Inorganic Chemistry.....2 (4)
Zoology.....3 (4)	English History.....5	Botany.....4 (4)
	Public Speaking.....(2)	Cooking—Women.....2 (6)
		Surveying—Men.....(4)

JUNIOR YEAR

English Literature.....2	English Literature.....2	American Literature.....2
German or Latin.....3	German or Latin.....3	German or Latin.....3
Physics.....4 (2)	Physics.....4	Entomology or Physical Chemistry } 3(4)
Histology, Botany, Feeds and Feeding, Civics and Constitutional Law, Analytical Geometry, Theoretical Chemistry, Domestic Economy (Women) } 10	Advanced Physiology, Botany, Farm Dairying, Civics and Coustitutional Law, Analytical Geometry, Grganic Chemistry, Domestic Economy (Women) } 10	Cellular Biology, Botany, Crops, Calculus, Psychology, Domestic Economy (Women), Organic Chemistry, Electricity } 10
	Public Speaking.....(2)	

NOTE: The student is required to elect any two of the subjects above included in brackets

SENIOR YEAR

Literature or Agricultural Chemistry } 3	Literature or Agricultural Chemistry } 3	Literature or Agricultural Chemistry } 3
Geology.....4 (2)	Advanced Book-keeping and Business Correspondence or General History } 3	Current History.....3
Law.....3	Bacteriology.....2 (4)	Bacteriology.....2 (4)
Social and Industrial History, Agricultural Physics or Mineralogy } 5	Forestry or Metallurgy and Assaying } 5	Botany, Industrial Chemistry, Astronomy or Feeds and Feeding and Plants and Plant Breeding } 5
Botany, Embryology, General Chemistry Calculus, or Sociology } 4	Calculs, Botany, Industrial Chemistry, or Political Economy } 5	Thesis.....(10)

NOTE: The right is reserved not to give any elective offered during the junior and senior years for which fewer than five students apply, although the effort will always be made to accommodate every student in this respect.

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AGRICULTURAL COURSE.

This course is designed to afford scientific training and practical knowledge to young men who expect to follow agriculture as a life work, or to prepare themselves as instructors of others therein. A two years' course (twenty weeks in each year) is also offered, detailed announcement of which is made in another place. The short winter courses in agriculture and mechanics (eight weeks) will be given as heretofore for the benefit of farmers who are not in a position to matriculate as regular students of the institution. These courses are fully set forth on a subsequent page.

THE COURSE IN DETAIL.

SUB-FRESHMAN YEAR

The Same as in General Science Course

FRESHMAN YEAR

FALL TERM	WINTER TERM	SPRING TERM
Rhetoric 5	Rhetoric 5	Etymology and Structure..... 5
German 5	German 4	German 4
Algebra 4	Algebra 4	
Physics 4	Geometry 5	Algebra 4
Freehand Drawing ..... (4)	Wood Work ..... (8)	Geometry 5
Nursery Work 1 (2)		Stock Judging 1 (6)

SOPHOMORE YEAR.

Advanced Rhetoric 2	Theme Work 2	Theme Work 2
Geometry 4	Trigonometry 5	Trigonometry 5
Soils and Fertility 3 (2)	Pomology 2	Vegetables and Small Fruits 3
Zoology 3 (4)	Inorganic Chemistry 3 (4)	Inorganic Chemistry 2 (4)
Inorganic Chemistry 3 (4)	Breeds 5 (4)	Botany 4 (4)
		Surveying ..... (4)

JUNIOR YEAR.

Physics 4 (2)	Physics 4	Entomology 3 (4)
Feeds and Feeding 5	Farm Dairying 3 (4)	Animal Breeding 5
Botany 5	Botany 5	Crops 5
Theoretical Chemistry 5	Advanced Philosophy 5	Cellular Biology 5
	Public Speaking ..... (2)	

SENIOR YEAR.

Agricultural Chemistry 3	Agricultural Chemistry 3	Agricultural Chemistry 3
Agricultural Physics 4 (2)	Bacteriology 2 (4)	Bacteriology 2 (4)
Geology 4 (2)	Forestry 5	Current History 3
Law 3	Farm Economics 2	Feeds and Feeding 3
Embryology 4	Advanced Book-keeping and Business Correspondence or Research Work in Agriculture or Horticulture ..... (6)	Plant Breeding 1 (2)
	Evolution of Cultivated Plants	Thesis ..... (10

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COURSE IN MECHANICAL ENGINEERING.

This course is intended to prepare young men for positions of usefulness and responsibility in the mechanical and electrical professions. The early part of the course is devoted to a thorough grounding in English, mathematics, and physics, mechanical drawing and shop work also being given. The last two years are devoted to the more technical engineering studies, including the higher mathematics, machine designing, steam machinery, and strength of materials. An electrical engineering course is given during the last two years, embracing the subjects of electrical measurements, direct and alternating current dynamos, motors, transformers, systems of power distribution, electric lighting, electric railways, etc.

THE COURSE IN DETAIL.

SUB-FRESHMAN YEAR.

The Same as in General Science Course.

FRESHMAN YEAR.

FALL TERM	WINTER TERM	SPRING TERM
Rhetoric 3	Rhetoric 3	Etymology and Structure 3
German 5	German 4	German 4
Algebra 4	Algebra 4	Algebra 4
Physics 4	Geometry 5	Geometry 5
Freehand Drawing ..... (4)	Woodwork ..... (8)	Foundry and Pattern Making ..... (8)
Nursery Work 1 (2)		

SOPHOMORE YEAR.

Advanced Rhetoric 2	Theme Work 2	Theme Work 2
German 4	Trigonometry 4	Trigonometry 3
Geometry 4	Inorganic Chemistry 3 (4)	Inorganic Chemistry 2 (4)
Algebra 2	Descriptive Geometry 5	Descriptive Geometry 5 (4)
Inorganic Chemistry 3 (4)	Mechanical Drawing ..... (6)	Mechanical Drawing ..... (4)
Mechanical Drawing ..... (6)	Public Speaking ..... (2)	Surveying ..... (4)

JUNIOR YEAR:

Physics 4 (2)	Physics 4	Electricity and Magnetism 4 (2)
Analytical Geometry 5	Analytical Geometry 5	Calculus 5
Kinematics 3	Applied Mechanics 3	Applied Mechanics 4
Steam Boilers 3	Valve Gears 3	Indicators 2
Blacksmith Shop ..... (8)	Machine Shop ..... (10)	Machine Shop ..... (8)

SENIOR YEAR.

Calculus 4	Calculus 4	Current History 3
Law 3	Advanced Book-keeping and Business Correspondence, or General History ... 3	Thermodynamics 5
Machine Design ..... 4 [4]	Machine Design ..... 4 [6]	Machine Design 4
Electrical Engineering ... 4 [6]	Electrical Engineering ... 4 [4]	Electrical Engineering 3
		Thesis ..... [10]

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SCHOOL OF AGRICULTURE AND DOMESTIC ECONOMY—TWO YEARS OF TWENTY WEEKS EACH.

This course is arranged with a double purpose: First, to provide instruction in agriculture and domestic economy requiring less time than the four years' course, and yet more extensive and systematic than the eight weeks' winter courses; second, to offer, in connection, such instruction in the common school branches as will prepare the student to enter the collegiate work. Applicants must be at least fourteen years of age, and fairly well advanced in the common branches, though they will be received and classified without formal examination. To meet the conditions of many young men and women in the country the course is arranged to begin on October 18, when the fall work on the farm ceases to be pressing, and to close March 16, when the services of the student are likely again to be needed at home. For those who can come at the opening of the fall term (September 12) and remain through the spring term, valuable review work in the common branches is offered, as shown below, both in the five weeks preceding October 18 and the ten weeks succeeding March 16, preparatory to entrance to the sub-freshman class. Students who are reasonably proficient in the common school branches, and students of mature years may take the agricultural and domestic economy work of both years in one, if they desire, and be excused from the other work of the course.

Following is the course in detail—the figures indicating the number of recitation hours per week, figures in parentheses indicating hours of practical work per week.

FIRST YEAR.

FALL TERM Ten Weeks—Beginning Oct. 18.		WINTER TERM Ten Weeks—Ending March 16.	
Arithmetic	5	Arithmetic	5
Spelling	3	Grammar	4
Geography	3	U. S. History	4
Writing	2	Veterinary Medicine, and Botany and Entomology	3
Livestock (Boys)	3	Sewing (Girls)	(5)
Sewing (Girls)	(5)	Veterinary Medicine, and Botany and Entomology (Boys)	(4
Stockjudging (Boys)	(3)	Drawing	(4
Cooking (Girls	1 (3	Cooking (Girls	1 (3
Drawing (Girls)	(4)		

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SECOND YEAR.

(Also preparing students for Sub-Freshman.

PRELIMINARY COURSE—Five weeks ending October 18. To be occupied with a review of arithmetic, spelling, geography, U. S. history, writing, and grammar, as covered in first year.

BALANCE OF FALL TERM Ten Weeks.		WINTER TERM Ten Weeks—Ending March 16.	
Grammar	5	Grammar	5
Civil Government and Commercial Law	3	Applied Arithmetic	5
Arithmetic	3	Soils and Crops	5
Horticulture and Floriculture	3	Stock Feeding (Boys)	3
Dairying	2	Sewing (Girls)	(6)
Poultry	3	Chemistry	3
Gardening	(2)		
Dairying	(2)		

SPRING TERM—March 16 to June 7. To be occupied with such studies as are necessary to fit for entrance to the Sub-Freshman class.

SHORT WINTER COURSES IN AGRICULTURE, HORTICULTURE AND MECHANIC ARTS.

During a portion of the winter term practical instruction is given in matters directly relating to farming, stock raising, and fruit growing, and the management of steam engines, with special attention to machinery used on farms. Any person over sixteen years of age may take this work, no examinations for admission being required. A circular describing the work of these courses in detail will be issued in November. In 1905, they will cover eight weeks from January 3 to February 24. The following list contains the work which will be given at that time:

Principles of Breeding—4 lectures.
Study of Breeds—10 lectures.
Stock-judging—10 lectures.
Diseases of Live Stock—18 lectures.
Stock Feeding—12 lectures.
Farm Dairying—9 lectures.
Crops for Oklahoma—18 lectures.
Farm Machinery and Equipment—12 lectures.
Steam Engines and Boilers—8 lectures.
Maintaining Soil Fertility—9 lectures.
Orchard and Small Fruits—18 lectures.
Troublesome Insects—9 lectures.
Elementary Botany—9 lectures.
Farm Hygiene; Water Supply—10 lectures.
Legislation and Laws Affecting Farmers—12 lectures.
Farm Accounts, Mortgages, etc.—12 lectures.

Work in blacksmithing, steam engines and boilers, veterinary practice, practical horticulture, and dairying will be given in the afternoon insofar as the facilities of the college will allow.

The lectures will be supplemented by practical work in the dairy,

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barns, shops, and orchards, designed to fix and illustrate the methods and practices advised. It is practical instruction throughout and planned to give the most that is possible in so short a time.

BUSINESS COURSE.

A complete business course is offered to students having the qualifications to enter the sub-freshman class (see page 6.) The course is as follows:

Fall Term: Book-keeping, spelling and writing, arithmetic, commercial law, English. Or, Stenography and typewriting, spelling, English.

Winter Term: Advanced book-keeping, banking and business correspondence, spelling and writing, arithmetic, English. Or, Stenography and typewriting, spelling, English.

Spring Term: Book-keeping, arithmetic, English. Or, Stenography and typewriting (including manifolding, letter-press work, typewriter dictation,) English.

SPECIAL WORK.

Students of reasonably mature years and adequate preparation are permitted to select special work under the advice of the faculty.

CO-EDUCATIONAL.

This institution is open to young men and young women on equal terms. Since the establishment of the department of domestic economy, for the theoretical and practical training of young women in those things which will fit them for the duties of every day life in the home, it is noted that the percentage of attendance of young women is increasing.

LIBRARY.

The college has a well selected library of about 10,000 volumes. The books are kept in fire-proof stack rooms, and a commodious reading room is provided immediately adjoining. Students are permitted under

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proper restrictions to take books to their rooms. The best reference books and the leading periodical publications are at the disposal of students.

SCIENTIFIC AND OTHER APPLIANCES.

In chemistry, physics, mineralogy, botany, entomology, zoology, physiology, mechanical and electrical engineering, agriculture, horticulture, and veterinary science, and domestic economy, the college is equipped with the latest and best appliances and apparatus, representing an outlay by the government of approximately $80,000. Paramount stress is laid upon the experimental and practical work of the laboratory, and the afternoons are practically given over to this character of instruction. In agriculture and horticulture the live stock, the implements of husbandry, the dairy, the green house, the forestry plantations, and the farm itself with its operations, constitute the laboratory. In mechanical engineering the wood working shops, machine shops, electrical shops, foundry, and blacksmith shops are in operation for practical work by the students. In chemistry the quantitative and qualitative laboratories are occupied by students practically every afternoon throughout the academic year. In botany and entomology the afternoon work is devoted to examination, analysis, and classification under the microscope. In zoology and comparative anatomy, practical work is given in the afternoon in connection with living, mounted, and unmounted subjects and with models. In bacteriology the laboratory work is devoted to the identification of bacteria, the action of disinfectants, the growing of colonies, the examination of substances for bacteria, etc. Freehand and mechanical drawing, book-keeping, and surveying are also given in the afternoon. In domestic economy the kitchen, dining room, and sewing room are constantly occupied for practical work in these lines.

EXPENSES.

Tuition is free. An incidental fee of one dollar per term is charged students entering from Oklahoma and Indian Territories. A fee of five dollars per term is charged students under twenty-one years of age entering from elsewhere. Text books will cost from $3.00 to $5.00 per term. Special students in stenography and typewriting are charged

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$2.00 per term for use of typewriter. A deposit of $2.00 a term is required of all students in the Sophomore class in chemistry to cover laboratory breakage. Board with room in private families can be obtained for $2.50 to $3.00 per week. Furnished rooms $1.50 to $2.50 per month, if two occupy the room. A considerable portion of the students board in students' clubs, thus reducing expenses in that line to $1.75 to $2.00 per week.

OPENING.

Entrance examinations for the fall term, 1904, occur September 12-13. Fall term begins September 14. For catalogue and full information, address

A. C. Scott, President,
Stillwater, Okla.

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OKLAHOMA AGRICULTURAL EXPERIMENT STATION.

REPORT OF DIRECTOR.

SUBJECTS OF INVESTIGATION.

The work of the station during the year has been directly in the line of development of that which has been in progress for several years. The growth of the Territory of Oklahoma and its closer connection with Indian Territory has brought increased demands upon this station and prevented the extension of its work so as to include many matters equal in importance to those now being investigated. Some of the experiments which have been in progress for several years are now about completed and others are being taken up as the resources of the station will permit.

VETERINARY DEPARTMENT.

In the veterinary department, the following work is in progress: The germ of hog cholera is being studied for the purpose of determining if it can be attenuated so as to be used to produce immunity. Immunity has been produced in rabbits and white rats by using cultures attenuated by growing at a high temperature but it has not been found possible to produce the disease in pigs by using virulent cultures of the germ. It may be that the germ under ordinary conditions is not the cause of hog cholera. In connection with this, the action of toxins filtered from cultures of various bacteria on the growth of the hog cholera germ is being studied.

Bacterial analyses of drinking water are being made. Samples were collected during the dry weather of the winter and again after the heavy spring rains for the purpose of ascertaining what per cent of wells show surface contamination.

The cultural characteristics of the tubercle-forming soil bacteria are

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being studied and experiments in inoculating soil for the growing of alfalfa and cowpeas have been started.

The manufacture and free distribution of vaccine for the prevention of blackleg in cattle has been continued. Abundant evidence has accumulated to show that the vaccine is entirely safe and effective in the hands of farmers. Uufortunately, many fail to avail themselves of this certain method of preventing losses from this disease. The use of the vaccine, however, is increasing and losses from the disease are becoming less frequent.

AGRICULTURAL DEPARTMENT.

The following are the lines of investigation in progress in the agricultural department:

A series of steer feeding experiments was started in the winter of 1899-1900 and from twenty to twenty-five steers have been fattened every winter since then. These steers have been divided into lots of five each and fed on different rations. The following feeds have been compared and used in different combinations: shelled corn, corn meal, Kafir meal, wheat meal, cottonseed, cottonseed meal, alfalfa hay, Kafir stover, prairie hay, wheat straw, and oats straw. All of these feeds and the rejected feed have been weighed and sampled as fed or collected and have been analyzed by the chemical department. The objects of these feeding experiments has been to study different combinations of these feeds as to their efficiency and economy in producing gains. A bulletin now in preparation will report the results of three years' experiments comparing alfalfa with Kafir stover and corn meal with Kafir meal. The results of one experiment with cottonseed products have been published in Bulletin No. 58. Other work with cottonseed products is planned to be carried out during the winter of 1904-1905. This will make three years' work with these and give fairly complete results. It will probably be necessary to discontinue steer feeding work for a time after next winter so that more pressing work in horse, pig and sheep feeding may be taken up.

For the past five winters, from twenty to twenty-five yearling steers have been roughed through with the common roughage raised on the farm. This feed has been supplemented with cottonseed and cotton-

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seed meal. In the summer, these steers were turned on pasture, and in the following fall, were divided into lots and put into the experiment pens for fattening. The steers were weighed at regular intervals and all of the feed given to them was weighed and recorded. This work has been done for the purpose of studying the individual gains and behavior of the steers before putting them into the fattening experiments and of ascertaining in a general way the gains made and the feed required under such conditions.

Work in pig feeding has been carried on in connection with the steer feeding. Each lot of steers has been followed by hogs for the purpose of ascertaining the value as pig feed of the droppings from the different lots of steers. At times, the pigs were compelled to live on the droppings; at other times, they were fed varying amounts of grain in addition. The study of the effect of cottonseed meal on pigs has been continued with the college swine herd.

Experiments have been started for the purpose of determining the value of cottonseed and Kafir corn products as feed for horses. These are being fed in comparison and in various combinations with common farm feeds. Different methods of preparing feed for horses will also be studied.

Field experiments with wheat include the following: continuous culture on manured and unmanured soil; rotation with corn, oats, and cowpeas, manured and unmanured; rotation with castor beans, Kafir corn, cotton, oats and soy beans, manured and unmanured; time of seeding; time of plowing; variety tests and seed selection; pasturing to ascertain the effect on yield. The continuous culture and rotation experiments will continue indefinitely and reports will be issued at intervals. The experiments in time of seeding and time of plowing will be completed with the present season's work and a bulletin summarizing the results for five years will be issued. Rye, emmer (speltz), barley, and oats are also being grown to determine their yields and adaptability to Oklahoma conditions.

Corn is being grown in rotation as indicated and variety tests are being made for the purpose of determining the value of different varieties.

Cotton is grown in rotation and variety tests are being made. A small gin has been purchased so that this work may be conducted more satisfactorily than heretofore.

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Kafir corn is grown in rotation and continuously on manured and unmanured soil; the improvement of Kafir corn by breeding and seed selection has been taken up and its yields and characteristics are being compared with Jerusalem corn and milo maize.

Forage crops such as sorghum, cowpeas, soy beans, rye, oats and wheat are grown and pastured by hogs, full records being kept. Variety tests of cowpeas and field trials of soy beans are also being made. Variety tests of peanuts and stock beets are being continued.

Experiments in seeding alfalfa on bottom and upland soils have been in progress for several years and notes are kept on the growth and yield of various fields of alfalfa. Methods of getting a stand of Bermuda grass on upland soils are being studied.

HORTICULTURAL DEPARTMENT.

The horticultural department is carrying on twenty-five distinct lines of investigation. In many cases, the same plats and plants are being used in more than one experiment. Fourteen of these experiments are variety tests and for that reason, are continuous in their nature. The plan is to cut down the number of varieties in each test as rapidly as possible and arrange to continue the tests on a small scale only. These tests have been in progress for several years and include the following: almonds, apples, apricots, blackberries, cherries, currants, dewberries, grapes, peaches, plums, quinces, raspberries, strawberries, and pears.

An experiment in methods of cultivating, pruning, and training grapes is well started and the vines will bear their first full crop this year. It will be at least three years before any definite conclusions can be drawn from this experiment. An experiment in methods of cultivating and pruning blackberries has been discontinued because of blackberry rust which destroyed a large number of the plants. Some results were secured and observations along this line are being continued.

The experiment in apple orchard cultivation has been extended to include the growing of cover crops and will be completed in two more years. This experiment is for the purpose of determining the relative merits of different methods of cultivation and the effect of growing early crops and fall cover crops in the orchard. A study of the cause

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and effect of wooly root has been in progress for three years but there are very few indications that the work will bring to light the cause of the trouble. The effect of grafting and top working trees is being studied for the purpose of determining the effect of grafting weak-growing trees in the tops of strong-growing trees. Spraying for the prevention of the codlin moth, using different insecticides and different methods of applying them is being carried on. The effect of fertilizers on the yield of tomatoes and on the relative weight of seed pulp and solid fruit is being determined for the second year. Different varieties of beans and methods of cultivation are being tested. A variety test of ornamental hedge plants has been started for the purpose of finding desirable hedges for this climate, the privet having been seriously damaged by disease. A test of the relative merits of different varieties and species of grapes when used as stock for grafting is being made.

The native fruit bearing plants of the territory are being studied and are being collected and planted as they can be secured. The purpose of this work is to determine the value of these native fruits as a starting point in developing varieties better adapted to our conditions than imported varieties.

BOTANICAL AND ENTOMOLOGICAL DEPARTMENT.

The department of botany is studying varieties of castor beans for the purpose of determining the relative value of the different varieties for purposes of breeding and improvement. This work has been in progress for three seasons. Little was accomplished last year because of damage to the plants by the false chinch bug. Of about forty sorts of castor beans used in this work, twenty have been eliminated. The collection of native grasses and plants is being extended as opportunity arises and it is hoped, in time, to cover the whole territory. Entomological work has been done in this department as the occasion arose, chiefly in connection with the Hessian fly which appeared in a few localities but which has not yet done much damage.

CHEMICAL DEPARTMENT.

The department of chemistry has made the fodder analyses of samples from the feeding experiments and the moisture determinations of the soil samples from the field experiments of the agricultural depart-

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ment. As opportunity arose, work was continued with the analyses of red and white Kafir corn. Much of the time of the department has been wasted in examining rocks of all sorts which continue to come to the station with requests varying from assays to complete analyses. Assays and complete analyses are never made of such samples, but it has seemed necessary to make mineralogical examinations in more than one hundred and seventy-five cases during the year. This sort of thing has been a source of annoyance ever since the station was established and the work which has been done along this line has been without result, either in the discovery of a single thing of value or in convincing some of the people of the territory that the minerals of most value in the soil of Oklahoma are those which are to be extracted by the growing of profitable crops. Analyses for the purpose of determining the fitness of waters for irrigation are made without charge when sampled in accordance with directions which are furnished to all applicants. Many samples of water supposed to contain oil have been received. The expense of sending may be saved by filling a bottle with the water on which the supposed oil floats and setting it aside for three days, shaking the bottle and removing the stopper daily. At the end of that time, the 'oil' will usually have settled to the bottom as a flocculent precipitate.

BULLETINS ISSUED.

The following bulletins were issued during the year:

No. 59, September, 1903.

Reprints from Bulletins Nos. 47, 50 and 52, and Annual Reports, 8 to 11.

This volume of reprints was made necessary by the repeated requests of new settlers for information contained in publications of the station which were out of print. It contains nothing which, in some form or other, has not been sent to all of the addresses on the mailing list and was sent only to those who requested it.

No. 60, December, 1903.

Planting Trees for Posts, Fuel and Windbreaks, by O. M. Morris.

A report of the results of experiments in tree planting made at the station and of observations of the results secured on farms in different parts of the territory.

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No. 61, January, 1904.

Field Experiments, by F. C. Burtis and L. A. Moorhouse.

A report of the results of experiments covering several years with sugar beets and mangels grown for stock feed, Kafir corn and Indian corn grown on upland soil, and oats.

No. 62, May, 1904.

Disinfecting Power of Coal-tar Dips, by L. L. Lewis, and J. F. Nicholson.

A report of the results of laboratory tests of Car-Sul, Chloro-Naptholeum, Cremoline, Creolin-Pearson, Lincoln Dip, Moore's Hog Remedy, and Zenoleum, and of Mortipest and kerosene emulsion.

No. 63, May, 1904.

Tuberculosis in Hogs, by L. L. Lewis.

A report of experiments in the transmission of tuberculosis to hogs by feeding them milk from tuberculous cows.

Press Bulletins, Nos. 98 to 109. These are summarized elsewhere in this report.

MAILING LIST.

The mailing list of the station continues increasing at a rate which makes it impossible to supply copies of bulletins to all who ask for them after they have been sent to the regular mailing list. It is most imperative that some provision be made by the next legislature for the payment of a portion at least of the cost of printing station bulletins and reports. Unless this is done, the station will be compelled to delay the publication of the results of several experiments now about completed or to condense them so that they cannot be presented satisfactorily. The states quite generally pay for the printing of the bulletins of their experiment stations. At the present time, the mailing list contains 19,289 names. In addition to this is the official mailing list furnished by the Office of Experiment Stations of the U. S. Department of Agriculture, making 21,000 copies of each publication necessary to supply the regular list. About five hundred requests for bulletins are received each month and at least two thousand above the requirements of the list should be printed. This cannot be done with the present revenue of the station.

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CORRESPONDENCE.

The usefulness of the station through the medium of correspondence is constantly increasing. This is one of the most important means of bringing the work of the station close to the every-day life of the farm and of keeping the members of the staff in close touch with conditions in remote parts of the territory. All questions are promptly and carefully answered and when possible, bulletins covering the subject matter of the inquiry are sent so that more complete information than can be given by letter may be supplied.

FARMERS' INSTITUTES.

The station co-operated with the Board of Agriculture in the work of farmers' institutes by sending one or more members of its staff to each of the annual meetings of the county institutes with two exceptions. Members of the station staff were present at three other farmers' institutes and acted as judges of livestock at four county fairs. The traveling expenses of station workers who attend farmers' institutes should be paid from funds other than the Hatch Fund and with the active organizations in each county of the territory, these expenses are much greater than formerly. While it is the duty of the station to encourage farmers' institutes, those who supervise the disbursements of the funds appropriated by Congress hold that the continuance of expenditure of this fund for the payment of institute expenses is not allowable. It is of great importance that station workers have an opportunity to attend these meetings so that they may present the results of the station's experiments and gather much of practical value from the other speakers and the discussions and it is hoped that provision may be made whereby the Board of Agriculture will have sufficient funds for the payment of necessary traveling expenses for this purpose.

BUILDINGS.

Aside from one cattle shed, there have been no additions to the building equipment of the station. There is great need for a building of sufficient size to accommodate the increasing work of the departments of agriculture, horticulture, and chemistry, and of the administrative offices of the station. Two of the departments of the station are on the

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second floor of Library Hall while the other three are each in different buildings, thus materially interfering with the efficiency of the station's work. The agricultural and allied work of the college continues encroaching upon the space available for station work and additional room is an imperative need.

THE STAFF.

In September, E. H. Riley succeeded R. C. Obrecht as Assistant in Animal Husbandry. F. O. Foster, Assistant in Agriculture, has resigned and his successor has not yet been chosen. A. G. Ford, Associate Chemist, has been appointed Chemist.

The division of salaries between college and station funds and of the time between teaching and experiment station work has been satisfactorily arranged and the results are already being shown in the increased work which the station is doing. There is absolutely no disposition to charge the station with college expenses; on the other hand, the station is now actually the gainer because of its connection with the college.

John Fields,

June 30, 1904.

Director.

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SUMMARY OF PRESS BULLETINS.

A press bulletin is sent out from the station on about the fifteenth of each month. These bulletins are sent only to newspapers and are intended to contain timely articles related to the work of the station and the agricultural interests of the territory. They have been printed in the agricultural papers and in many of the daily and weekly papers of the territory. The station appreciates the assistance of the editors who have thus aided in extending the station's usefulness. Some of the articles may have a permanent value and are reprinted in this report for convenient reference. They are, of necessity, fragmentary and, in part, a repetition of matter contained in regular station bulletins.

WHEAT EXPERIMENTS.

During the season of 1902-1903 the following wheat experiments were carried on: pasturing wheat; early, medium, and late seeding; early, medium, and late plowing; continuous cropping to wheat with and without manure; seed selection, and variety test. Most of these lines of investigation have been under way at this station since 1893 but in the fall of 1899 the plans were rearranged and modified with the view of closing some of the experiments with the crop of 1903-04 at which time a complete bulletin will be issued, giving the results of the past ten years. In the meantime those interested are referred to the press bulletins for the results that have been obtained from year to year. These are reprinted in the annual reports of the experiment station.

EARLY, MEDIUM AND LATE SEEDING.

The plan of this experiment has been to make a seeding the middle of September for early seeding, the middle of October for medium seeding, and the middle of November for late seeding. Six large plots were prepared in every respect alike and two of them seeded on September 15, and two on October 13, but at no time between the seventh of November and late spring was the ground dry enough to seed, so the late seeding had to be abandoned for this season. The following are

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the results for the past season and the averages for the three and four years:

	Grain Bu. Per Acre	Average for Four Years
Early Seeding	30.6	31.82
Medium Seeding	28.7	31.06
Late Seeding	——	*20.49

*Average for three years.

Red Russian wheat has been used in this experiment and seeded on all plots at the rate of 1 1-2 bu. per acre. The crop of 1902-03 was of the very finest quality. The yield and quality of the grain from the September and October seedings usually differs very little. The September seeding usually affords more pasture and during some seasons on rich soils suffers if it is not pastured. The October seeding is less likely to be hurt in the fall by such insects as grasshoppers, chinch bugs, and Hessian fly. The November seeding is usually very uncertain and backward and the crop is always more affected by rust which often makes the quality very poor.

EARLY, MEDIUM, AND LATE PLOWING.

Two plots were plowed July 16 for early plowing, two August 18 for medium plowing, and two September 13 for late plowing. All were plowed about eight inches deep, run over with the disk immediately after plowing and then worked down at intervals as showers fell. As usual the July plowing was performed with much greater ease than the later plowings and before the weeds or grass had made much of a start. The August and September plowings were done wtih great difficulty and the ground plowed up very lumpy and was very open and rough even after going over with disk. But this difference in condition was nearly all obliterated by a fall of three inches of rain in September after the late plowing was done. What little difference existed in the different treatments after the September rains was entirely overcome by a fall of 7.78 inches of rain in November, hence the plots might be said to be all of the same treatment for the past season. All were seeded on October 7 with Fulcaster wheat at the rate of 1 1-2 bu. per acre.

The following are the results for the past season and the average for four years:

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	Grain Bu. Per Acre	Average for Four Years.
Early Plowing (July)	26.1	30.00
Medium Plowing (August	26.9	27.07
Late Plowing (September)	27.2	25.65

The wheat from these plots tested 61.6 lbs. and was of a very fine quality. July usually affords an opportunity for plowing wheat ground while it is moist and before the weeds and grass have started much, and while it is in a condition to plow with the greatest ease and economy. If given proper tillage after plowing, seldom is there a season so dry but what such plowing is in good shape for seeding at the proper time. Ground that is not plowed until August or September is generally dry and hard and covered with weeds and grass, many of which have gone to seed. Such ground is usually plowed with the greatest difficulty and it is only by taking advantage of every light shower that falls that it can be got in proper tilth by seeding time. As a rule it is very dry, cloddy and open at seeding time and the seed starts poorly and if good rains do not come in the fall the crop is very light as compared with early plowing.

WHEAT, CONTINUOUS, WITH AND WITHOUT MANURE.

In 1893 an acre of virgin soil was laid out and seeded to wheat and continuously cropped to wheat without the addition of fertilizer or manure of any kind until the fall of 1898 when it was divided into two plots. One of these received a coat of barnyard manure at the rate of 15 tons per acre in the fall of 1898, and another application at the rate of 11 tons per acre in the fall of1899. Since then no manure or fertilizer has been applied. The other half of the acre has been continued as started in 1893, no manure or fertilizer being applied. The continuous cropping of wheat has been followed on both plots.

The fall of 1902 these two plots were in fine condition for seeding. They were seeded on October 8 and Fultz wheat, as in most cases during former years, was used and at the rate of 1 1-2 bu. per acre.

The following are the results for the past season and the average for five years, and the bushels of grain produced per acre in the five years.

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	Test per bu.	1902-3 yield per acre Grain bu.	Straw tons	Av. per acre for 5 years	Bu. per acre in 5 years
Plot 1, Manured	62.7	27.6	2.16	30.02	150.1
Plot 2, Unmanured	61.7	20.3	1.39	18.74	93.7

The wheat from both plots was of a very fine quality. According to the above table, four years after any manure had been applied the manured plot made 7.3 bu. per acre more than the unmanured, which at the price of wheat at thrashing time would amount to $4.08. In the five years the manured plot yielded at the rate of 56.4 bu. more of wheat per acre than the unmanured plot, which at 50 cents per bu. would amount to $28.20, the pay for applying 26 tons of manure on an acre of ground. The expense of harvesting and thrashing the larger yield on the manured plot is not taken into consideration.

VARIETIES AND SEED SELECTION.

Twenty-five varieties were under test the past season. Most of them have been grown on the station farm since the season of 1892-93 and were selected as the most promising kinds from a list of over 250 grown at the station that season. New varieties have been introduced from year to year as any were found with merit enough to make it worth while to try them. It might be said here that no new variety has been found that gives any better yield than some of the old established varieties that have been taken care of and seed graded from year to year with the fanning mill.

The following are the yields for the past season of the most important varieties: Red Russian, Missouri Blue Stem, Pickaway, Early Red Clawson, German Emperor, New Red Wonder, Big English, Sibley's New Golden, Crimean, Paris, and Fultzo-Mediterranean ranged in yield per acre from 36 to 39 1-2 bu. Fulcaster, Early Ripe, Turkey, Oregon Red, and Gypsy Amber yielded from 33 to 36 bu. per acre; Fultz, Eversaw, Weissenburg ran from 30 to 33 bu. per acre.

The season of 1902-03 on the whole was quite favorable to a large wheat crop of fine quality. Heavy rains fell in September, the fall for the month being 4.64 inches, and in November the conditions were extreme as 7.78 inches fell in that month. Enough fell in that month to keep the soil wet until a short poriod during the first week in May when the ground in wheat fields was getting a little dry but this spell

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was broken early in the month and 9.27 inches fell before the close. The fall for April and June was light for those months but sufficient for a maximum growth of wheat. Cool weather kept the rust from developing to a dangerous extent and the wet weather literally exterminated the chinch bugs for the time.

(August, 1903.)

PASTURING WHEAT.

This work was started the fall of 1902 and will be continued several years. Due to the exceptionally wet season, the plans as laid out were interfered with and had to be modified for the occasion. During the whole season, with the exception of very short intervals, the ground was too wet to pasture without tramping it quite badly. Some few farmers took the precaution of turning their stock on their wheat only when the ground was frozen but these times were few and of short duration, and most of the fields of wheat in this locality were pastured continuously and much of the time the stock would sink into the mud as deep as the ground was plowed.

The plots with which our experiment was carried on were located on a field of wheat belonging to a farmer who lived a short distance from the station. The land might be said to be third bottom, rather a heavy soil, somewhat flat in location but fairly well drained. The wheat was seeded late in September and early in October. The ground had been plowed and heavy rains at the time of seeding settled it and put it in fine shape and gave the wheat a good start. Seven and three-quarters inches of rain fell in November and the month was extraordinarily wet. By the first of December the wheat had made a moderate growth and the owner of the field turned horses and cattle into the field at this time; some care being taken to let them on in the mornings when the ground was frozen and remove them for a portion of the day during times when the ground was very soft. This precaution was not followed very closely during the latter part of the season. The spring growth of wheat made a good start early in March and the pasturing was continued until March 31, when the stock was removed. The field was well tramped and eaten over and was full of tracks two and three inches deep. For use in our experiment half-acre plots were laid out in

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the above field and each plot fenced, with the exception mentioned later, so that they could be pastured as little or as much as we desired with the stock running in the field, by leaving the gates on the plots open or shut. The following is the treatment given the different plots and the effects.

PLOTS VII. VIII. AND IX—FIELD PASTURED.

These plots were unfenced and all received the same treatment as the rest of the field in which they were located, which has been noted above.

PLOT VI—HEAVY WINTER PASTURED.

This consisted of the cattle being turned on to this plot in December and being allowed there most of the time until February 5. During that time the ground was badly punched up and the wheat cropped off fairly close. Taking the stock off in the early spring gave the wheat a chance to get a good early start.

PLOT III—LIGHT WINTER PASTURED.

This consisted of allowing the stock on this plot a few days early in February when the ground was in fair shape and it was tramped up but very little.

PLOT I—LATE SPRING PASTURED.

This treatment consisted of turning the stock on this plot March 31, and then shutting five or six head of cattle on the plot April 8th and every day thereafter until the 14th, with the exception of the 10th when the ground was too wet. At the time of turning the stock on, the growth was fine and large and when the stock was taken off the wheat was eaten very close to the ground, and the ground tramped more or less.

PLOT II—VERY LIGHT WINTER PASTURED AND LATE SPRING PASTURED.

This plot was treated the same as Plot I with the exception that it was pastured a few days early in February.

PLOTS IV AND V—NOT PASTURED.

As might be inferred, at no time during the season did these plots have any stock on them. While there was a fairly vigorous growth

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on these plots, at no time did it reach the stage where there was any danger of it smothering out or lodging like wheat which is not pastured does quite frequently in this country.

The following is the yield per acre of the different treatments:

	Grain Bu. Per acre.	Straw Tons.
Field Pastured	20.5	1.17
Heavy Winter Pastured	18.7	1.06
Light Winter Pastured	20.9	1.35
Light Winter and Late Spring Pastured	10.7	.83
Late Spring Pastured	14.0	.94
Not Pastured	23.2	1.49

The quality of the wheat from the spring pastured plots was quite inferior to that of the others, testing 58 lbs. while that from the others tested from 61 to 63 lbs. per bushel. The unpastured plots were the earliest in maturing, but were very little different from the others, with the exception of the spring pastured plots, and as compared with these there was several days difference.

No rust or chinch bugs bothered these plots to speak of and everything was favorable for a good crop. The continued wet weather might be said to have made the conditions for pasturing unfavorable, but it was quite fortunate that rains continued up to harvest so as not to allow the ground to bake after being tramped while wet. Just about the time the wheat was heading, the ground was getting quite dry and if this little drouth had not been broken just when it was by abundant rain it is doubtful if the wheat on the pastured ground would have been worth cutting. If the conditions had been suitable for the development of the rust, the pastured plots, particularly the spring pastured, would have suffered much more than the plots not pastured.

(September, 1903.)

DELAYED GERMINATION OF WHEAT.

Because of unusually dry weather in some portions of Oklahoma, some of the fall sown wheat has not yet germinated and there is much discussion as to whether or not a crop of wheat may be expected under

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such conditions. Some of the wheat germinated after it was sown and died back later. It is not probable that such wheat will produce much of a crop and it would be better to plant this land to some spring crop, rather than let the wheat remain. Where the whole plant has died, there is of course no possibility of a crop being produced.

If the weather continues dry until about the first of March, and then there are rains followed by open weather without hard freezes, the wheat which has not yet germinated may be expected to grow and to make a fair crop of late wheat. Rains followed by cold weather will almost certainly rot the seed and a hard freeze just as the wheat is coming up will greatly weaken it. But if there is no serious interruption in the growth of the wheat after it starts, yields much the same as those secured from late fall seeding in the usual season may be obtained. The ripening will be delayed and there will be more damage from rust, if weather conditions are normal, than on wheat which ripens earlier. On the farm of the experiment station, wheat sown in November has yielded but two-thirds as much as that sown in September and October and of a very inferior quality.

Those who have wheat which has not yet germinated should watch conditions closely and unless there is a good chance for the wheat to grow, early in March ,oats, barley, or emmer (speltz) should be sown on the same land disturbing the wheat as little as possible. Such wheat as may grow will not damage the value of these crops as feed. Then if other portions of the wheat field are not doing well in April, other spring crops may be planted. (January, 1904.)

THE OATS CROP.

The oats crop in Oklahoma was cut short last season by rust, and there are indications that there will be a diminished acreage of oats this spring. There is a fair profit in growing oats in Oklahoma and even including the low yield of last year, the average yield of oats on the experiment station farm for the past four years has been forty-three bushels of grain and one and one-third tons of straw per acre. The Texas Red variety has given the highest yield of the varieties tried and is quite generally grown.

Early seeding of oats is desirable. The first of February is not

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too early in open seasons but seeding during the first half of March usually gives as good results as earlier seedings. There is a rapid falling off in seedings made after the middle of March.

Oats do best on a well-settled seed bed. If the ground is to be plowed, it should be done in the fall or winter. The success of the crop depends largely on the compactness of the seed bed. If the land was in a cultivated crop the previous season and was kept in good tilth it is doubtful if it is economy to plow it for oats. It should, however, be well worked with a disk harrow or cultivator. Getting the crop in early is of more importance than is any special method of preparing the soil.

A liberal seeding pays. It keeps the weeds from starting and the plants do not tiller as much as with thin seeding. The heading and ripening are more uniform and the crop will not suffer as much from rust because the plants will not grow rank and they will mature earlier. Three bushels of seed per acre are sown on the station farm. On poorly prepared ground, more than this should be used. Drilled oats are not as likely to suffer from short dry spells in the spring as are oats broadcasted and harrowed in. Plowing or cultivating oats in usually gives an irregular stand. (January, 1904.)

SEED FOR SPRING CROPS.

During the fall and winter is the time for the selection of seed for spring crops. When the rush of spring work comes on, there will be no time for it. If the seed corn was not selected in the field, it should be picked out at once from your own corn or from the best grown locally under conditions similar to yours. Uniform ears with uniform grains so that they will be dropped regularly by the planter, should be chosen, and in shelling, the grains on the butts and tips should be discarded because of their irregularity. Without regularity in the size and shape of the grains, no form of dropper will give a perfect stand which is essential to a large yield.

Kafir corn affords an opportunity for improvement by seed selection. It, as well as corn, is best selected in the field, but if this has not been done, uniform heads with large grains should be selected and stored in a dry place. Much of the Kafir corn which is being grown in Oklahoma is badly mixed because of neglect in the selection of seed.

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Cottonseed should have been selected from the early pickings and stored in thin layers so as to prevent heating. The oats crop last season was light and seed oats should be run through a fanning mill for the purpose of removing the light material. Unless this is done, it will be difficult to determine how much good seed is sown and much of the poor seed will result in weak plants that will produce an inferior crop or none at all.

Careful and continued seed selection on the farms of Oklahoma will pay many times for the work. Plants become adapted to the conditions under which they are grown and while it is desirable to try new varieties from other localities, such new seed should never be used for the entire acreage of any of the staple crops. After the new varieties become acclimated, they may be found better than those commonly grown. If such is the case, locally grown seed will then be on hand for the entire crop and there will be no loss. (December, 1903.)

CHOOSING SEED CORN.

Many of those who grow corn are firm in the opinion that it is necessary to 'change seed' frequently. They say that their own variety or strain of corn has 'run out' and that they must buy vigorous seed from some other locality. Is this necessary? Must growers of corn every few years buy high-priced seed in order to maintain their yields? It seems that the answer to these questions is another question: How did the man who sells the new and vigorous seed keep it from 'running out' while he was growing it? Dosen't the whole proposition appear absurd?

It is true that the corn which has been grown may be giving diminishing yields of inferior quality and that purchased seed corn may yield more and of a much better quality. But the difference it not due to any unavoidable tendency to deterioration inherent in the corn plant. It is largely the result of differences in the manner of selecting the seed. If the seed corn has been collected for several years by gathering it up with a scoop shovel from the leavings in the corn crib in the spring and if the seed which is purchased was grown by a man who practiced proper methods of seed selection, the difference is accounted for. It

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is in the nature of the man and not in that of the corn plant that the trouble lies.

Oklahoma is justly famed for the wheat which its farms produce, yet in 1899, the only year for which figures are available, the value of the corn crop of the territory was only $300,000 less than that of the wheat crop, the yield being a little less than 29 bushels per acre.

There are few localities where corn is grown that do not now possess types of corn adapted to the conditions existing there. A few farmers grow better corn and more of it than their neighbors. They are more or less careful in the selection of their seed corn and it is from their cribs that seed should now be selected for next season's crop. If possible the selection should be made from corn grown on similar soil and in a location similar to that on which it is to be grown, for corn becomes, under proper selection, adapted to its environment. A sort of corn that yields abundantly on rich bottom land will be out of place on drier uplands. Corn that has become adapted to upland conditions will not be at its best on rich bottom lands.

Having found a desirable type, pick out enough seed corn for your next crop. Take your time to it for each bushel of that seed corn ought to bring from 250 to 400 bushels of corn next fall and it is worth spending time upon.

First find an ear that may be used as a standard by which the others may be measured. It should not be the largest ear in the crib but it should have deep, wedge-shaped kernels compactly laid on in uniform rows, a medium sized cob, and its butt and tip well-filled. The proportion of length of ear to circumference should be about four to three; for bottom land, the ear may be 10 inches long and 7 1-2 inches in circumference; it may be 9 by 7 or 8 by 6 for thinner soils. The grains on the ear should be uniform in size, color, and shape, thus showing that the variety characteristics are well fixed. If the corn is white, the cob should be white; if yellow, the cob should be red.

With this ear as a guide, pick out about twice as much corn as will be needed for seed for next season's crop and take it home for study and selection as you find time. It would have been better if this corn had been selected in the field so that the character of the plants as well as of the ears might have been observed. It's too late for that now, but

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this should be done next fall. Go over the corn carefully and choose from it an adequate supply for seed, remembering that about one-fourth of it is to be discarded during the shelling.

A good stand of plants is required for a large yield of corn and to secure a uniform stand, all of the grains of seed corn must be as nearly as possible of one size and shape. For this reason, the grains on the butts and tips of the ears and ears with imperfectly shaped grains should be discarded when shelling and after the corn is shelled, it should be picked over and all imperfect grains and trash removed.

A germinating test should be made. Put 25 grains on moist paper in a cigar box and cover them with a moistened cloth. Tie the lid of the box down and set in a moderately warm room. At least 23 of the 25 grains should have sprouted before the end of five days. The amount of seed to be sown should be increased proportionately or other seed procured if less than this number germinate.

Try the plates on your corn planter and keep changing them until the kernels are dropped regularly at the distances apart which have been found best in your locality. Without regular dropping, a good stand cannot be secured and without it, maximum yields are impossible.

All of this may appear to be a lot of trouble and expense but corn returns from 200 to 400 times the amount of seed required and the work pays well. It is by the use of such methods that the yield of corn per acre has been increased more than one-fifth in ten years in Illinois and one-eighth in Indiana. There is no grower of corn in Oklahoma who cannot carry out the foregoing suggestions and profit largely by it. The character of seed corn is of the highest importance, for corn is almost essential to the profitable production of live stock, and any system of farming that does not include livestock in it is incomplete.

(February, 1904.)

COMPARATIVE YIELDS OF KAFIR CORN AND INDIAN CORN.

Oklahoma farmers are fortunate in having at their disposal a large variety of crops from which selections can be made to suit any locality or particular line of farming. When commencing to plan for the various crops which are to be planted on the different fields of the farm

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it is important that the characteristics of the crops that are to be selected be considered. Plants, like animals, have inherent qualities and these qualities have to be taken into account when it is contemplated to place a certain plant within a given environment or use a special breed for a special purpose. No intelligent farmer would think for a moment of placing a large herd of Jersey cows on his ranch and expect to produce first class beef cattle for the market. He would select cows from the list of beef breeds taking those individuals which are best adapted to range conditions. Climate and soil are determining factors in such a choice. In northern sections where the winters are somewhat severe and pastures furnish a scanty fare, the shaggy black with his thick coat and long hair is well fitted to withstand such treatment while in other sections greater success would be attained if the roans or white-faced cattle were selected. The qualities that are characteristic of these breeds were not taken on in a single year, but became fixed in the course of many decades through the patient work of the breeder who labored continually with a definite purpose in view.

Since care and judgment must be exercised in the selection of breeding stock in order to gain a certain end, the selection of crops demands as much if not greater attention where the highest standard is to be reached. In the semi-arid sections of the west farmers do not pretend to cultivate the red clover plant because they already have at hand that king of forage plants, alfalfa, which is so well adapted to the soil and climate of this country. It is true that plants can be placed under conditions that are not congenial and by persistent effort the habits of the plant may be so changed that it will thrive under such surroundings. In other words it might be said that the plant has acquired certain qualities which enable it to adapt itself to the changed conditions. The question that arises, however, is one of expediency. Will it not pay to give attention almost exclusively to the improvement of those plants which are at the present time best adapted to our peculiar needs?

In making a comparison of the yields of Kafir corn and Indian corn which have been obtained within the past four years it is advisable to consider, not only the character of the soil and season, but also the adaptation of these crops to Oklahoma conditions. Kafir corn is a native of South Africa. Prior to its introduction into America the plant was cultivated in places where the climate is hot and dry. Thus Kafir corn has acquired certain qualities which enable it to overcome

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adverse conditions such as periods of prolonged drouth or excessively hot weather. These qualities which are so advantageous have become more intensified as the plant has been introduced and grown in those portions of the country where adverse conditions are met. Kafir corn grows best on rich mellow soils, but at the same time good crops can be raised on medium and upland soils where the supply of plant food is not as abundant as in bottom lands.

Indian corn in indigenous to America and appears to thrive best in those sections of the country where the July temperature ranges between 70 and 80 degrees F. Rainfall affects the yield to quite a marked extent, and in the semi-arid districts high yields are not certain unless irrigation is resorted to. Average uplands soils in Oklahoma are not especially adapted to the growth of Indian corn. During favorable seasons good yields can be expected from fields of this description, but past experience would lead one to form the opinion that the season cannot be depended upon. Consequently, it would be wisdom to plant the crop that will invariably give a fair return. In Oklahoma there are large areas of farm land that belong to the class just described and many farmers are endeavoring to raise Indian corn on such land. Their attention may not have been directed to the fact that greater profits can be secured by growing Kafir corn on this type of soil. In the following table a comparison is made of the results obtained at the Experiment Station on unmanured, medium upland soil during the past four years:

	Kafir corn per A.		Indian corn per A.	
Year	Lbs. of Stover	Lbs. of Grain	Lbs. of Stover	Lbs. of Grain
1900	4600	1744	3260	1063
1901	4230	1506	1380	5
1902	4500	1154	1424	1440
1903	4360	1620	1740	979
Av'g 4 yrs.	4422	1506	1951	622

In examining these figures it will be noted that Indian corn was a complete failure during the season of 1901 taking grain alone into consideration, while Kafir corn gave a very fair return. Again, taking the yields which are given for Indian corn for four consecutive

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years, wide variations are apparent both in yield of grain and in yield of stover. With Kafir corn, however, the results are quite uniform throughout the entire period. The average yield of Kafir corn for the four years is 884 lbs. per acre in advance of the average yield made by Indian corn. The difference in the average amount of stover produced by these two crops is 2471 lbs. in favor of Kafir corn.

A study of these results brings out two important facts:

First, Kafir corn has given fair yields under adverse conditions and for average upland soil may be depended upon to give better results than Indian corn.

Second, The hot, dry weather which occurs about the time that Indian corn is tasseling is very detrimental to the process of fertilization. This, in part at least, is an explanation for exceedingly low yields during certain seasons. (March, 1904.)

FORAGE RAPE.

Each succeeding year demonstrates the value of rape as a forage crop in Oklahoma. This crop makes a rank, succulent growth on good rich soil and is pastured off while green or is cut and fed from day to day as a soiling crop. Rape is sown from the first of March until the last of May and sometimes later. The earlier seedings are the most successful, since the crop is not injured by frosts and when sown early, it gets well-rooted before dry weather. When well established, it withstands dry weather very well and the crop sown in the spring will furnish feed until hard freezes come in the winter, if the crop is cultivated. pastured, and cut properly. Late summer and fall seeding has usually been a failure at the experiment station.

If the forage is wanted only for spring and early summer use, the seed may be broadcasted but if it is needed for summer and fall, the seed should be drilled in rows eighteen to thirty inches apart so that cultivation may be given and the surface of the soil may be kept loose. The tramping of the ground by stock may be diminished to some extent by turning them on the rape patch for a short time twice a day.

If rape is cut for soiling purposes, it should not be cut closer than

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four inches from the ground or the plants will not start up quickly. If the growth gets ahead of the stock and becomes stale and old, it should be mowed and then a fresh growth will start. At times stock, especially hogs, refuse to eat the rape growing on a certain patch. The reason for this is not known. Many trying the crop for the first time have concluded that it was not satisfactory. Probably if the rape had been grown elsewhere, or in another season, this trouble would not have been experienced.

The cost of the seed is a small item, about eight to ten cents a pound. When drilled in rows thirty inches apart, from one to two pounds of seed per acre are required. (January, 1904.)

BERMUDA GRASS IN WINTER.

Last winter some Bermuda grass went through without damage while some was either killed or frozen back so far that it was very slow about starting in the spring. Those who lost a stand of Bermuda grass were discouraged and considered the grass a failure when in many cases, it was the fault of the treatment which the grass had received.

There is but little trouble from Bermuda grass freezing out in the southeastern fourth of Oklahoma and in fact, all over the eastern half, it withstands the cold very well. On very loose soils, the loss from winter-killing is greater than on hard soils. Often the main root survives while all the roots formed on the runners are killed. When the grass is thoroughly established, it withstands cold better. On the farm of the experiment station, Bermuda grass plantings survived the winter of 1898-99 when the minimum temperature was seventeen degrees below zero, thus showing that extreme cold does not of necessity kill the grass.

The greatest trouble is experienced in northwestern Oklahoma and it is not certain that Bermuda grass is sufficiently hardy to succeed as a pasture grass there. The degree of success attained in southwestern Oklahoma is about the same as in the northeastern part and is encouraging.

Much Bermuda grass was started last spring, both from sowing the seed or by planting the roots and the season has been favorable for se-

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curing a good start and it is very desirable that it be given a fair chance for its life during the coming winter. A covering of some sort is desirable. If the grass is not pastured or mowed closely from October 15 until cold weather, it will make enough growth to protect itself in some measure. A top dressing of well rotted manure during November after the freezing weather has killed back the tops will be much protection in addition to supplying plant-food for next season's growth. The work of putting manure on the first season's growth will be well repaid for it is probable that the grass will take care of itself afterward. And up to the present time, no other grass has shown as much promise of success as a pasture grass for Oklahoma. (October, 1903.)

DESTROYING BERMUDA GRASS.

Those who fear that Bermuda grass does too well with them may kill it out by plowing two to three inches deep in December, after allowing stock to graze it closely. After freezing weather in January or February, the land should be plowed again six or eight inches deep, well harrowed, and seeded thickly to oats as soon as the weather is warm enough, usually about March 1. Cowpeas should be planted on the oats stubble immediately after harvest and after they are mowed, pastured off, or plowed under, wheat should be sown. This method will effectually remove the Bermuda grass, though why any farmer should want to get rid of it when pasture grass is as scarce as it is in Oklahoma is hard to understand. (November, 1903.)

PONDS FOR STOCK WATER.

In December, 1902, the experiment station published the following description of a pond with a capacity of about one million gallons for storing surface water for stock purposes on the station farm: "The pond is on a hill and gets its water from the sod land above. Water is piped to all of the feed lots, and flows by gravity to the second floor of the barn. As it runs from the faucet, it is as clear as the average well water and it tastes good. The cost of building the pond and of piping the water for about one-third of a mile was about four hundred

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dollars. Barring unusual accidents it should cost nothing for repairs and it dosen't cost a cent to operate. It is possible that in time the pipes may become clogged with sediment, the fall being so slight that the water does not go through the pipes with sufficient force to keep them clean."

This pond has now been in use two years and continues supplying all of the water for every purpose, except drinking water for the men, on the farm where about one hundred head of cattle, one hundred hogs, and ten head of horses are kept. During the six months ended May 1, 1904, the rainfall was but three and one-twelfth inches, yet the pond continued furnishing all of the water required and there was still a good supply on hand when good rains came. This is about as severe a test of the capacity of the system as may be expected soon to occur again.

The pond is fenced and precautions are taken to prevent the contamination of the area which drains into the pond. It would be better if the drainage all came from sod land which is cut over for hay and in laying out new farms, this should be taken into account. The dam is now covered with a heavy growth of Bermuda grass which effectually prevents washing and willows have been planted at the high-water level to protect the inside of the bank. (May, 1904.)

STEER FEEDING EXPERIMENTS.

The steer feeding experiments at the station the coming winter will include twenty-five two year old grade steers and these will be divided into five lots of five steers each. Each lot will be fattened on a different ration and the following combinations will be used. The amount of feed is for a 1000 pound steer for one day.

Ration I—Cottonseed, 7 lbs; alfalfa hay, 16 lbs; wheat straw, 6 lbs.

Ration II—Cottonseed, 4 lbs; Kafir meal, 11 lbs; alfalfa hay, 13 lbs; wheat straw, 4 lbs.

Ration III—Cottonseed meal, 3 lbs; shelled corn, 12 lbs; prairie hay, 5 lbs; wheat straw, 8 lbs.

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Ration IV—Cottonseed meal, 10 lbs; wheat straw, 12 lbs. (1-3 of straw to be cut or chaffed and mixed with meal as fed.)

Ration V—Corn meal, 15 lbs; alfalfa hay, 12 lbs.

The food nutrients (the material available for assimilation by the steer) contained in the different rations are given in the following table:

	Pounds per day for a 1000 lb. steer					
	Dry Matter	Protein	Carbo-hydrates	Fats	Nutritive Ratio	Cost cents
Standard						
1st Period	30.0	2.5	15.0	0.5	1:6.5	
2nd Period	30.0	3.0	14.5	0.7	1:5.4	
3rd Period	26.0	2.7	15.0	0.7	1:6.2	
Ration No. 1	26.0	2.66	10.65	1.32	1:5.2	17.3
Ration No. 2	29.0	2.56	13.67	.99	1:6.3	18.6
Ration No. 3	25.0	2.24	13.57	1.04	1:7.0	18.9
Ration No. 4	20.0	3.77	6.04	1.26	1:2.4	15.6
Ration No. 5	24.0	2.40	14.75	.79	1:6.9	15.4

Rations I, IV, and V have been used in some of our previous steer feeding experiments and are repeated here in order to get further results and enable them to be compared with those from other combinations of feeds. Rations II and III have not been used in steer feeding work before at this station.

Rations I, II, III and V furnish the nutrients approximately as given in the feeding standard and from that standpoint might be said to be normal rations. Although a ration very similar to ration IV is used considerably, it is a ration that differs widely from the standard.

Ration V, which consists of corn meal and alfalfa hay, has been under test at this station for several years, and first class results obtained from it. Starting with two year old steers weighing about 1000 pounds, they have been successfully fattened in about five months, in which time they put on 335 to 395 pounds per steer and consumed 2350 to 2540 pounds of corn meal and 1614 to 1817 pounds of alfalfa hay. These figures taken in connection with the market cost of feeds in a locality will enable the feeder to figure the cost of fattening a steer on this ration. This ration might be varied, by reducing the alfalfa hay 1-2

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or 1-3 and adding some prairie hay, straw, corn or Kafir stover, and adding a pound or two of cottonseed meal in the place of the same amount of corn meal, and the addition of a pound or two of cottonseed is advisable in many cases.

With the ruling prices of feeds Ration IV, consisting of cottonseed meal and wheat straw, would not be an economical ration and a feeder wanting to make the most out of his operations should not use it, although steers have been put in marketable condition on it and at a profit in certain seasons. With corn costing as much as the cottonseed meal or even a third more it would be profitable to replace a portion of the cottonseed meal with it. Good results are expected from Ration II, which consists of cottonseed, Kafir meal, alfalfa hay, and wheat straw. The cottonseed will act as a divisor in the Kafir meal preventing the steer from bolting it and leaving it in a more open condition in the stomach. Ration I, cottonseed, alfalfa, and wheat straw, is not introduced as a feasible ration for the average conditions. It was found in our previous experiments that cottonseed as the sole grain and fed with carbonaceous roughage as wheat straw and prairie hay, was a failure for fattening steers, but when fed with a highly nitrogenous roughage as alfalfa hay very good gains were received. The latter combination was fed but a portion of the fattening period and the time was too short to give much idea what results might be obtained on feeding the ration 4 to 5 months.

The combination of the cottonseed meal, shelled corn, prairie hay, and wheat straw in Ration III has not been used in steer feeding at this station, but a ration very similar to this has been used successfully for fattening hundreds of steers. The price of finished beeves, four to five months from now is very uncertain, and the carefully selected and compounded ration will do much in assuring a profitable outcome to the operation. (November, 1903.)

FEEDING EXPERIMENTS.

Following are a few of the results obtained in the steer feeding experiments carried on during the past winter, 1903-04. It has been the custom of this station to issue a brief report at the close of each

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year's work as it takes some time to get the complete results compiled for a bulletin.

The following rations were fed to lots of five steers each. The feeding period extended from November 11 to March 30, covering 140 days.

Lot 1; fed cottonseed, alfalfa hay and wheat straw; gained 240 lbs. per steer or an average daily gain of 1.71 lbs. Feed consumed per steer, 710 lbs. of cottonseed, 2306 lbs. of alfalfa, and 94 lbs. of wheat straw.

Only three steers are calculated in this lot as two had to be removed before the experiment was completed; one with lumpy jaw and one with an injury in his stomach.

Lot 2; fed four parts cottonseed and eleven parts Kafir meal, alfalfa hay, and wheat straw; gained 328 lbs, per steer or an average daily gain of 2.34 lbs. Feed consumed per steer, 528 lbs. of cottonseed, 1602 lbs. of Kafir meal, 1915 lbs. alfalfa hay, and 229 lbs. wheat straw.

Lot 3; fed cottonseed meal, shelled corn, prairie hay and wheat straw; gained 272 lbs. per steer, or an average daily gain of 1.94 lbs. Feed consumed per steer, 516 lbs. of cottonseed meal, 1757 lbs. of shelled corn, 854 lbs. of prairie hay and 622 lbs. of wheat straw. For the first 70 days the grain consisted of three parts of cottonseed meal and twelve parts of shelled corn, for the last 70 days, four and a half parts cottonseed meal and thirteen and a half parts shelled corn.

Lot 4; fed cottonseed meal and wheat straw; gained 160 lbs. per steer, or an average daily gain of 1.14 lbs. Feed consumed per steer, 1615 lbs. of cottonseed meal and 1274 lbs. of wheat straw. Of the straw fed this lot, four pounds per day was chaffed and mixed with the meal when fed.

Lot 5; fed corn meal and alfalfa hay; gained 319 lbs. per steer, or an average daily gain of 2.27 lbs. Feed consumed per steer, 2120 lbs. of corn meal and 2048 lbs. of alfalfa hay.

The steers were sold April 4 on the Kansas City market in lots as they were fed. The following table gives the selling weights and prices, the shrinkage in shipping and the per cent that the lots dressed out:

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	Average K. C. wt	Price per cwt	Shrinkage per steer	Per Cent dressed out
Lot 1	1230	$4.10	39	57.6
Lot 2	1344	$4.35	39	58.7
Lot 3	1294	$4.20	53	56.7
Lot 4	1182	$4.10	33	57.1
Lot 5	1352	$4.25	35	59.2

Each lot of steers was followed by three hogs during the experiment. Early in the experiment they were compelled to live largely on the droppings of the steers. With the exception of lot 3 that followed the steers getting the shelled corn, the pigs made very small gains during that time. Lot 3 made fair gains. Towards the latter part of the experiment, each lot was fed a liberal feed of corn meal in order to put them in condition to ship with the steers. These pigs were healthy and in fair marketable condition and sold in a bunch at $5.20 per cwt. at Kansas City. The following are the weights of the lots at the beginning of the experiment, the gains per lot, and the extra grain fed:

	Weights per lot	Gain per lot	Corn meal per lot
Lot 1 (3 hogs)	595	332	1437
Lot 2 (3 hogs)	594	431	1315
Lot 3 (3 hogs)	567	531	907
Lot 4 (3 hogs)	592	398	1501
Lot 5 (3 hogs)	577	428	1296

There was quite a difference in the condition of the different lots before the heavy grain feeding commenced.

The steers were common native grades of more or less mixed breeding but Shorthorn blood was most in evidence. They averaged about 1000 lbs. at the beginning of the experiment and were three-year-olds at the close. As might have been expected, an examination of the carcasses in the cooler showed more or less difference in the finish between some of the lots, but further no ill effects due to any of the rations could be seen.

Below is given a rough statement of the fianancial outcome of the feeding:

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	Profit or loss per steer	Profit per pig	Total (5 steers, 3 pigs)
Lot 1	$ .45	$3.17	$11.32
Lot 2	$2.80	$5.07	$29.19
Lot 3	$1.63—	$7.58	$14.60
Lot 4	$4.34—	$4.08	$ 9.44—
Lot 5	$ .52	$4.85	$17.16

The labor is not taken into account as the manure is considered as balancing that. The first cost of the steers was computed at $2.75 per cwt., and the first cost of the pigs at $4.00 per cwt. The feeds were figured as follows per cwt.: shelled corn, 66 cents; corn meal, 71 cents; cottonseed, 70 cents; cottonseed meal, $1.22; Kafir corn, 57 cents; Kafir meal, 62 cents; alfalfa hay, 40 cents; prairie hay, 30 cents; wheat straw, 15 cents. The freight on the steers was 23 cents per cwt; on the hogs 30 cents. In addition to the freight, the expense of yardage, feed and commission was $1.01 per steer and 25 cents per hog. (April, 1904.)

PREVENTING BLACKLEG.

The station has issued a bulletin giving directions for using vaccine for the prevention of blackleg in cattle. This disease causes heavy losses of young stock every year and practically all of this loss may be stopped by vaccinating with properly prepared vaccine. Every stockman should have a copy of this bulletin which will be sent free to all requesting it. (July, 1903.)

VACCINATE FOR BLACKLEG.

Cattle are low in price but there is thus all the more reason for doing all that is possible to prevent losses by disease. Blackleg still continues to cause much loss in Oklahoma in spite of the fact that this disease may be entirely prevented by the very simple operation of vaccination. For the past four years the experiment station has been furnishing the required vaccine free of charge and the distribution is still being continued. About a year ago it issued a bulletin giving full de-

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tails about blackleg and the manner in which the operation of vaccination is performed. This bulletin will be sent by the station to all who wish information about the disease.

The work of vaccination may be done by anyone who will carefully follow the simple directions which accompany all vaccine sent out. A heavy hypodermic syringe is necessary for injecting the vaccine. This and the other necessary articles for preparing the vaccine for injection are furnished by the station at cost. One outfit will last for years and often several farmers go together and buy an outfit for their use. The cost of the outfit by mail or prepaid express is $4.50.

Blackleg is an infectious disease and animals dead from it should be burned or buried deeply without skinning. When such an animal is skinned, the infection is spread with the hide and blood and, since the blackleg germ lives for a long time, further losses are assured whenever conditions are right for the propagation of the disease. Usually only animals under two years of age die of blackleg and, in most cases, only the fattest ones are attacked by the disease. All requests for vaccine should be addressed to the Experiment Station, Stillwater, Oklahoma.

(December, 1903.)

CATTLE MANGE OR TEXAS ITCH.

That this disease exists in western Oklahoma is quite certain as a portion of the Territory has been placed under quarantine. As a general rule Oklahoma has been very free from this disease as it has only been reported once or twice and then in small herds. Neighboring states have been to a certain extent troubled with this disease. This is especially true of portions of Kansas, Nebraska and Colorado.

To successfully cope with the trouble the stockman should know exactly what is causing the trouble, the history of the disease and especially the means of preventing its spread. The last is of great importance to those who do not have the disease among their cattle as they will be able in a great measure to keep their cattle healthy. In many cases the presence of lice on stock may be mistaken for mange as lousy cattle will rub a great deal and are unthrifty, but an examination will determine this, as the lice and nits are easily found.

Mange is a very contagious disease and will spread rapidly among

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cattle and can be communicated from cattle to horses and vice versa. The disease is always caused by a very small mite that lives either in or on the skin, depending on the species. There are several varieties of mange mites but mention will be made only of those that cause the greatest amount of trouble to cattle and horses. There are two varieties of the mite affecting cattle; one that lives on the surface of the skin (Psoroptes communis var. bovis) and generally spreads over the greater portion of the body, while the other variety, (Symbiotes bovis) is very rare and is generally found at the base of the tail but through neglect may spread along the back or down the thighs.

The effect of these mange mites is to produce an intense irritation of the skin by piercing it to obtain food. This causes an intense itching, the cattle rub a great deal, and in many cases the hair is completely removed from portions of the body. Crusts and scabs form on the body and in chronic cases the skin becomes thickened, dry and insensible. Both varieties of the mites found upon cattle are large enough to be seen with the naked eye and one can be certain whether it is mange or not by scraping off some of the scales and scabs and placing them on dark paper in the sun. If the disease is mange or itch you will be able to see very small objects moving on the paper or over the scabs.

The mite causing the greatest amount of trouble to horses is the Sarcoptes equi. These mites burrow into the skin and are very minute in size, so small that it is necessary to use a magnifying glass to be sure of their presence. On account of the mite burrowing into the skin the disease is more difficult to cure in the horse than in cattle. The disease is generally first seen on the nose or some portion of the head and extends back over the neck and body until in neglected cases the disease will spread over the entire body of the animal. The disease is easily carried from one animal to another by harness, blankets or in fact any article that may be used on a diseased animal and then brought in contact with animals that do not have the disease. Probably the most common way of spreading the disease is by saddle blankets as the disease is frequently seen on the back where it is located from the blanket. This particular mange mite of the horse is easily transferred to man, and such cases are very common where the disease is among horses that are continually handled.

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From a sanitary point of view mange is a very important disease as it is easily spread by contact with diseased animals or by coming in contact with fences, cars, etc., where diseased cattle have been. It is not a fatal disease, as it is very seldom that it kills except in case of weak animals, where the disease has been for some time, but in all cases it prevents good growth and is easily spread through the herd. The disease is more common during the early spring than any other season and can be easily recognized at this time, but it will almost entirely disappear during the summer with just enough of the infection left over to spread among the cattle during the winter.

Treatment: Where the disease exists to any extent the only practical thing to do is to construct a dipping vat and dip the stock in some solution that will kill the mange parasite. There are a number of commercial preparations that can be used to dip cattle in, such as Zenoleum. Chloro-naptholeum, or Lincoln disinfectant. These are all used for dipping purposes and will prove effective in one and one-half to two per cent solutions. Vats constructed on the same plan as those used to destroy ticks will be found best for this purpose. Among the various remedies that may be prepared at home the tobacco and sulphur dip and the kerosene emulsion will be found to be very effective and cheap. The ingredients for these can be obtained at any general store and where there are only a few head of cattle to handle it will be cheaper to make a few gallons of either of the above dips and spray or mop them.

Kerosene emulsion: Hard soap, 1-2 pound; kerosene (cheap grade) 2 gallons; water, 1 gallon.

Cut the soap into shavings and boil in the water until the soap is dissolved. Remove from the fire and add the kerosene and churn or spray back until the mixture is thoroughly emulsified. To this emulsion add six gallons of water, mix or spray back again, and use this for spraying.

Tobacco Dip: Tobacco leaves or plug, 1 lb.; sulfur, 1 lb.; water, 6 gallons. Place the tobacco in one gallon of water and allow to stand for twenty-four hours, then bring the water to the boiling point, remove from the fire and allow to stand over night. Mix the sulfur with another gallon of water and when ready to dip or spray, remove the tobacco levaes from the infusion, mix this with the sulfur water and

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add four gallons of water. In using any of the dips or sprays it is necessary to thoroughly wet the animal so as to soften the crusts and scabs and allow the solution to reach the parasite. One treatment is generally sufficient for cattle as the mite is on the surface of the skin but in horses, where the mite is generally burrowed in the skin, the treatment should be repeated in twelve to fifteen days. (July, 1903.)

LUMPY JAW.

The experiment station has had some experience with lumpy jaw as some of the cattle purchased for experimental feeding showed well marked cases of the disease some time after they were purchased. The disease is easily recognized and most stockmen are thoroughly familiar with it. Since the disease has the common name of lumpy jaw, from the fact that it most frequently attacks the bones of the head and especially the jaw, many think it does not attack any other portion of the body, but tumors are frequently found in the tongue, in the tissues under the skin, and in the internal organs.

By opening tumors that appear in the region of the head and neck one can be reasonably sure whether the disease is lumpy jaw or not by the character of the pus. In an ordinary abcess or boil the pus is generally thin and watery while that from lumpy jaw is thick, yellowish, and ropy and if the bone is diseased there will be small hard particles of bone mixed with the pus.

The cause of the disease is a vegetable parasite or fungus which is generally supposed to be taken into the body with the food and in those cases where the bones of the jaw are diseased the fungus probably enters the tissues through some small wound in the mouth, such changes for infection being especially abundant during the period when cattle are shedding or cutting their teeth.

In some cases the tumor may be dissected out when it is located in the muscles or loose tissue under the skin. The treatment employed by the station was the use of potassium iodide. Two things were learned in connection with the treatment, one being that the drug may be given with safety in larger doses than are usually prescribed and the other that in many cases where the disease is not cured the trouble is

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that the treatment has not been continued long enough. This is especially true in severe cases or where the disease is of long standing. From the experience gained in treating the few cases referred to above the following is advised: Where the animals weigh over seven hundred pounds give the potassium iodide in doses of two drachms each twice daily until the dandruff shows abundantly in the hair and the eyes become watery. This will usually take from five to seven days. After this condition which is called iodism is established the treatment must be stopped for from five to seven days and then repeated as before with the interval of rest until the drug has been given for five periods in the severe cases and four periods in the milder ones. During the last two periods the amount of potassium iodide may be reduced to two drachms daily. In one case treated the animal appeared entirely well at the end of the third period when the treatment was stopped but the disease reappeared after an interval of a few weeks and the entire treatment had to be repeated when it was continued for five periods. The ulcers and tumors will begin to dry up and the discharge grows less as the treatment progresses and by the end of the third or fourth treatment it has usually stopped but the drug should be given for at least another period. When the above treatment is fully carried out there will be a very small per cent of the cases that are not completely cured. (October, 1903.)

HOG CHOLERA.

Hog cholera and swine plague are the principal diseases of hogs that appear in the form of an epidemic and that are considered very infectious and contagious. Both diseases generally appear in any given outbreak but the general name of hog cholera is applied to such outbreaks as well as to several other diseases that appear among hogs. It has been generally recognized that hog cholera is due to a bacterium commonly designated as the hog cholera bacillus. This germ is present to a great extent in the alimentary canal and is passed from the body of the sick hog in large numbers and in this way infects lots and pens where the sick hogs are. Such infection may be easily taken into the body of the well animal with food and water and in this way soon infects the entire lot.

When the disease appears among the hogs of a given locality, as

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on a certain farm, it is evident that the pens are infected. This infection may be carried to the pens in a number of ways but generally by means of some sick animal or on the shoes of parties who have been in pens whese the sick animals are. In any case the first thing to do is to move the well hogs into fresh lots where there will be no communication with the pens where the sick ones are kept. If others take sick the well ones should be moved again as it will do little good to move out the sick ones and leave the others to take the disease in the infected pen. Washings from infected lots when carried into streams will spread the disease to farms located further down the stream and hog raisers should be especially careful of their water supply when the disease is in their locality. They should not allow hogs to take water from a stream when the disease is know to be on farms above them.

There has been a great deal of work done to find some cure or preventive for hog cholera. Certain lines of work seem to indicate that a system of vaccination may be perfected that will act in a similar manner on hogs as a means of preventing hog cholera, as vaccination does on cattle to prevent blackleg. If such a method is found to be reliable the disease will be practically under control. The feeding and care that hogs receive will do much to prevent such diseases, as unthrifty herds are the ones most likely to contract any disease. Plenty of green feed such as cane, alfalfa, etc., with a good supply of fresh, clean water during the summer months will do a great deal towards keeping hogs in the best possible condition.

The experiment station has devoted considerable time to the study of hog cholera and the transmission of the disease by means of the hog cholera bacillus. This work has been principally along the lines of producing immunity in the small experimental animals and studying the effect of the germ in the hog. To facilitate work of this character it is very desirable to know of the existence of this disease and any one having diseases of this nature among his hogs will aid the station in this work by communicating the fact and giving a thorough description of the symptoms and course of the disease. (May, 1904.)

PLANT WINDBREAKS.

The hard wind during September and the early part of October has made many a man wish for a windbreak for his house and barnyard.

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The comfort afforded by a windbreak around the house and farm building at such a time far more than pays for the time and trouble of growing and caring for the trees. A protection for the garden and berry patch is also of great importance and often amounts to the difference between success and failure. A hard wind during July or August will take as much water out of the ground in one day where it has full sweep and is not checked by a break of some kind, as it will in four days where the land is protected by a windbreak. The loss occasioned by such winds is not only the loss of water but direct damage to the plants by being broken off at the roots, having the fruit shaken off, and limbs broken out of the top.

The windbreak on the farm should serve the double purpose of being a windbreak and a wood lot furnishing a constant supply of posts, fencing material and fire wood. This is an item of no small amount on prairie farms. A good supply of young timber close at hand will save so much time and money that no farmer can well afford to be without it. The improvement in the appearance and the value of the farm will more than overbalance the expense of the planting and the care of the trees for the first five or six years and after that there will be very little labor required to keep the planting in good shape. (October, 1903.)

FRUIT VARIETIES.

The question of what varieties of fruit to plant has been a very hard one for fruit growers and farmers in Oklahoma to answer. It is now no less important than it has been in the past but it is much easier to select the proper varieties. There are now a good number of varieties that do well in all parts of the territory, and new varieties are being brought out that have been discovered here and prove their worth. The parentage of many of these varieties is known but in most cases it is not. This has very little or nothing to do with the value of the variety and is of interest only as a matter of history.

There are now a good many varieties coming into bearing that are supposed to be new but that have been in cultivation for a long time in some of the eastern states and have not been widely disseminated or planted in the west. Some few of these old varieties are showing a great

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deal of merit in some localities and are worthy of extensive tests. The Rutter pear has been found to be a case of this mistaken identity. This is an old variety but new to most people and promises to become a very popular pear. The Winesap apple has also passed for the Arkansas Black and has thereby won much favor for the latter unworthy variety. Many of these mistakes are the results of fraud by tree peddlers, one variety having been sold and a different and more common one delivered in its place. In some cases this has worked to the ultimate benefit of the farmer, as in the case of selling Arkansas Black and delivering Winesap instead. In most cases, however, where substitution has been made without the knowledge of the buyer, cheap and inferior varieties have been used.

A variety of real merit and of doubtful identity should be identified and called by its proper and original name, but if it cannot be identified with a reasonable expenditure of time and effort, a name should be given it, and it should be propogated and placed upon the market. It is more satisfactory to have all fruit named but the name should always be held secondary to the real value of the fruit. Many varieties will prove of value only in small localities, but are none the less valuable for home use.

Bulletin No. 59 of the experiment station contains information of much value to all who are interested in fruit growing. (December, 1903.)

PLANTING RED CEDAR SEED.

The seed of the red cedar should be gathered in the fall and winter and separated from the pulp. This can be done by rubbing the pulp through a sieve or soaking for a few hours in strong lye water and then rubbing the seeds out with the hands. After the seeds are washed out, let them dry for a day or two and then store in moist sand in a cool place. The seeds should be kept moist, not wet. They do not sprout until the second spring and are easily killed by excessive drying during the summer. A good plan is to mix the seed with sand in a small box that can be moved from place to place. In the winter, the box of seed and sand can be set in the shade of the house or a shed, and in the summer placed in the cellar.

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The seed is planted in the spring in beds about like onion seed and the bed cared for in about the same way. If the soil is inclined to bake on top it is a good plan to shade the bed with brush or cloth. The young plants grow best in sandy or sandy loam soil. Keep out all weeds and grass and give the land frequent shallow cultivation. The young plants grow very slowly for two or three years and may be left in the seed bed for that length of time. Transplant the same as other trees only use extra precaution to see that the roots do not become dry while exposed to the air. Cut the tops of the plants back more than is usually done with other trees when they are transplanted, as the cedar is in full leaf.

The seed may be planted the spring after it is gathered but it is more difficult to keep in good condition when so handled. The dry, hot summer is sure to destroy the vitality of most of the seed.

(January, 1904.)

ARBOR DAY.

The Governor of Oklahoma has proclaimed Friday, March 18, 1904 Arbor Day. Those who plant trees in Oklahoma need not feel that they are working entirely for posterity, for here it takes but a few years with proper attention to transform a bare prairie into a beautiful grove.

The American Elm, the Hardy Catalpa, and the Black Locust are excellent trees for planting and, with proper care on suitable soils, make rapid growth.

The American Elm, or White Elm, is a large tree and when full grown often attains a height of one hundred feet and a trunk diameter of six feet. It forms a round or broad and spreading top. It is a rapid grower and adapts itself wel to all kinds of soils. This is the best shade tree that is planted in Oklahoma. The tree is hardy, seldom attacked by insects and diseases and casts an ideal shade. It is a first class tree to plant about the house and yard.

The Catalpa is a rapid growing tree, often attaining a height of sixty feet and a trunk diameter of three to four feet. It grows best on a deep rich soil and a satisfactory growth can seldom be secured on a light, thin soil. In a pure planting the trees will completely shade

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the ground in three or four years. It sprouts well from the stump when the trees are cut in the winter.

There are two species of Catalpa, *Catalpa speciosa* commonly called Hardy, or Western Catalpa, and *Catalpa Catalpa,* commonly called Southern Catalpa. The Western catalpa is a tall upright tree with but few large branches. It requires close planting to develop a good trunk. The Southern catalpa is a low growing tree with a broad top. These characteristics are influenced by soil and location. On poor soil in open planting, both kinds form low, branching heads. The Western catalpa as a rule produces only one to three seed pods in a cluster, and each pod is from fourteen to twenty inches long and one-half inch in diameter. The seeds are large, broad, and about the same width the entire length. The filaments at the end of the seed are parallel or spreading. The bark of the tree is thick and deeply furrowed. The Southern catalpa produces from four to eight pods in a cluster, and each pod is from eight to ten inches long. The seeds are small and tapering at the end. The filaments are drawn together and are sometimes twisted. The young branches of one season's growth are enlarged at the joints. The bark of the tree is thin and scales off in large thin scales.

The Black Locust, or Yellow Locust, grows rapidly and attains a height of sixty feet and a trunk diameter of three feet. The top is of good form with a main central stem when grown in close plantings, but it frequently branches and forms a large round head when grown in the open. It grows fastest when set in mixed plantings but does not form as good a trunk. It usually grows more rapidly than the other trees and branches and spreads over the tops of other trees. It casts a poor shade and is slow to occupy the ground to the exclusion of other plants. It sprouts vigorously from the stump and roots broken by the plow or spade. While responding to good treatment, the black locust withstands neglect and is being grown successfully on upland soils in nearly every part of Oklahoma.

To thrive ,a planting of trees must have as thorough cultivation as a potato patch. It is useless to stick trees in the ground and give them no further attention. But cultivation induces a pleasing and profitable growth and every town in Oklahoma bears witness to the success which rewards the intelligent effort directed toward the growing of trees.

(February, 1904.)

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METHODS OF COMBATING THE HESSIAN FLY.

The damage done by the Hessian fly to the wheat in some of the northern parts of Oklahoma during the past season was sufficiently serious to give rise to a general demand for information as to the best methods of combating that insect pest. The habits of this fly are such that after its eggs are once laid on wheat there is practically no way of destroying the insect without destroying the plants.

It has been found that some varieties of wheat are very little, if at all damaged by the fly, even when grown alongside of other varieties that are entirely ruined. Before sowing wheat in the fly infested region, the farmers should secure seed of such a resistant variety. The varieties with large, coarse, strong straw are the ones that are most likely to be resistant. But, as it has been found that a variety that is resistant to the attack of the fly in one locality may not be resistant to it in another, the best way to obtain such a variety is securing seed from wheat that is known to have actually made a good yield while exposed to the fly under circumstances that resulted in damage to other varieties. If it is impossible to obtain such seed grown in the fly infested neighborhood, the next best plan will be to get seed from the same source as that which is known to have done well in spite of the fly. Anyone having secured a good yield of wheat in fields so planted as to be fully exposed to the fly, should advertise such wheat for sale as seed.

While seeking to secure a variety of wheat which will resist the attack of the fly it is well to do what can be done to reduce the number of flies that will be on hand to lay eggs on the wheat. These insects usually spend the summer and part of the fall in the "flax-seed" stage in the stubble, or as "flax-seeds" or maggots in the bases of the stalks of the volunteer wheat. Therefore, in order to destroy them it is advisable that the stubble and volunteer wheat be thoroughly plowed under several weeks before the winter wheat is planted. This plowing should be done to a depth of six inches or more, and if a jointer be used the work should be more thorough. If volunteer wheat and stubble are not thoroughly buried by this plowing, so as to imprison the flies in the ground, the soil should be worked over so as to break up clods and pack it down.

Where any attempt is made to reduce the number of flies by plowing

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them under, all the unplowed wheat stubble in the neighborhood should be plowed about the same time.

The sowing of strips of wheat to trap the flies has been recommended as another means of destroying the insects. For this purpose strips of wheat are sown on one or more sides of the fields in August. Then immediately before the remainder of the field has been sown in the fall, these trap strips are to be plowed under.

One of the practices recommended further north is sowing late, so that wheat comes up after the flies which would lay their eggs on it have been killed by the first frosts. This method of late seeding sometimes fails in the north, especially when late mild weather brings more of the flies to the mature egg laying stage after the early frosts. And it is likely to fail more often so far south as Oklahoma, where the weather may be mild enough for the egg-laying flies at almost any time during the winter.

The Hessian fly has its natural enemies, as do most of the insect pests, and some of these are a species of four-winged flies which are parasitic on the larvae (maggots) of the Hessian fly. And these parasites serve to a great extent to keep the pest in check. But it is not advisable to depend entirely on these parasites to reduce the number of flies when they are very numerous.

Anyone who would like to know what the Hessian fly looks like would do well to rear a few of them from the "flax-seeds" which are to be found within the sheaths at the bases of the injured wheat stalks. If some of the infested stalks are partly dried and placed in a glass fruit jar which is covered, the adult flies may emerge from the "flax-seeds" in a week or two. To insure success stalks might be placed in different jars at intervals of about a week, so that if the insects are too young to stand drying at first, older ones may be tried later. The stalks are dried in order that they may not mold in the jars.

Bulletins illustrated with drawings of the flies in various stages of development may be obtained from the experiment station.

(August, 1903.)

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CHECKS FOR MIGRATING CATERPILLARS.

The "garden webworm" previously reported to have attacked a crop of alfalfa at the experiment station, was observed, after the crop had been greatly damaged, to be migrating into some adjoining plats of cotton, and various methods were tried for preventing the caterpillars from destroying the cotton.

The most satisfactory barrier to the migration was a dust furrow, in which a log was dragged as often as seemed desirable. In most cases where these insects are found to be migrating, this will probably be the most practical method of dealing with them. Lines of tar and other sticky substances were tried, and were found to be effective as long as they remained sticky, but they required to be renewed too often for practical purposes.

Paris green was applied to the cotton plants which the worms were not prevented from reaching. It seemed most effective when applied in a spray. For this purpose 8 pounds of slaked lime were thoroughly mixed with a pail of water; four ounces of Paris green were mixed with a small quantity of water and added to the lime in water; and the mixture was added to, and thoroughly mixed with, a half barrel of water. While constantly stirred, this mixture was sprayed on the cotton plants with a nozzle which under-sprayed the leaves. Paris green was also applied to the leaves by a powder blower, and by sifting through a bag. The use of Paris green and other asrenites may not prove profitable for treatment of large fields, but may be very useful in gardens and along the sides of fields into which the caterpillars are traveling.

(September, 1903.)

THE WEBWORM ON COTTON AND ALFALFA.

On the 18th of June it was reported to the experiment station that a webworm was doing considerable damage to the cotton in some parts f Lincoln county, but no specimens were sent to the station for idenification. Since that time a webworm has appeared on cotton and on lfalfa near Stillwater. This has been identified as the so-called garen webworm, *Pyrausta rantalis.*

The natural food of this insect seems to be some of the species of pig-

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weed. In the first reports of damage by this insect this season it was stated that the "worms" seemed to go to the cotton from weeds. The United States Entomologist has stated that this caterpillar will probably never do serious damage to cultivated crops ,except where these weeds have been allowed to run wild for a season or so and are then plowed under and the land planted to some useful crop. It is possible that the growth of weeds in the first planting of cotton, which was destroyed by the wet weather, was the means of multiplication of the first brood of caterpillars this season.

The remedy for all leaf-eating caterpillars is to spray or dust the leaves with Paris green. The simplest method of applying the Paris green which has been extensively used is by sifting it from sacks of coarse ducking material attached to the ends of a stout pole which is carried across the saddle by a man on horseback and constantly jarred by rapping on the pole with a club. By using a pole long enough to hold four sacks, four rows are sometimes dusted with the poison at once. This method is described in detail by the Mississippi Experiment Station as follows:

"Make two sacks of heavy cloth, each about ten inches long and four inches in diameter, open the whole length of one side and firmly sewed at the ends. We have found 8-ounce osnaburg the best cloth for the purpose. Take a strip of oak or other strong wood about 1 1-2 by 2 inches and five feet long, and bore a one-inch hole 5 inches from each end. Tack one of the sacks to each end of the pole, fastening one of the edges of the opening to each of the narrow sides of the pole.

"The sacks can be filled by pouring the poison through a funnel inserted in the holes through the poles, and distributed by riding on horseback through the cotton rows, dusting two rows at a time. A little practice will enable one to do this work very evenly, and care must be taken not to allow the sacks to touch the leaves when wet or the poison will not pass through. When the sacks are freshly filled a very slight jarring will shake out a sufficient amount of the poison, but when they are nearly empty the pole should be frequently and sharply struck with a short stick or spaces in the rows will be missed.

"When used in this way we have found it the best plan to use the poison without any admixture of flour, and if flour is to be added lighter cloth should be used in making the sacks.

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"With a pole and sacks as described, one man and mule can poison from 15 to 20 acres per day."

Where the caterpillar works on alfalfa it is usually checked by removing it from the field with the cut alfalfa. When this is done it is found important to cut the hay uniformly close to the ground.

(September, 1903.)

A DISEASE OF THE PRIVET.

Some of the privet hedges of Stillwater are being greatly damaged if not destroyed, by a fungus disease of a sort which is called "anthracnose." The fungus of this disease attacks and kills the bark and wood of the stems. Starting at a point on the stem, it spreads through and around the stems. When the leaves of the plant first begin to wither, the place attacked by the fungus may often be located just below the lowest of the withered leaves and above the green ones, if there are any such on the shoot. Close inspection reveals the fact that the bark is slightly shrunken at the point of injury, and, if the stem be sliced lengthwise, the diseased wood and bark will be found to be discolored, while that below, if healthy, will be fresh, and that above simply seasoned. The wood above the point of the first attack dries out, and the fungus seems to spread down the stem to the crown of the plant, and from there to all the roots and stalks.

About the point of first attack black spots appear on the bark ,and when the bark thus spotted is scraped or cut, it is found that these spots are the openings of sporebearing pustules.

Hedges which have not yet been injured by this disease should be closely watched, and at the first sign of attack by this disease all the injured shoots should be cut off below the affected part and burned. If the crown or roots are affected the plant should be removed bodily and burned.

In case the hedge is badly damaged it will probably be best to remove it entirely and not plant privet in the same place, as the soil is likely to be infected with the spores of the fungus. Diseased hedges are a menace to healthy ones in the neighborhood.

It has been recommended that the hedges which are exposed to

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infection by this anthracnose be sprayed with Bordeaux mixture, especially in the spring, at the time when the buds are swelling and expanding, and while the new shoots and leaves are tender.

(September, 1903.)

BULLETIN NO. 59.

Oklahoma farmers who have not received the previous publications of the experiment station at Stillwater, Oklahoma, should send at once for a copy of Bulletin No. 59. This bulletin consists of reprints of Bulletins Nos. 47, 50 and 52 and of annual reports, 8 to 11. It will be of special value to new settlers in the western and southwestern counties. It is a book of two hundred pages and will be sent only on special request for it. (October, 1903.)

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ANNUAL PRECIPITATION (INCHES) OKLAHOMA.

Data furnished by C. M. Strong, Section Director, Oklahoma and Indian Territory Section, Weather Bureau, Oklahoma City.

STATIONS	COUNTY	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	Average
Ames	Woods								30.97		32.34		23.78				29.00
Arapaho	Custer						21.47	31.03	25.19	26.69	35.64	28.92	29.86	18.28			27.07
Beaver	Beaver								11.84			21.08	16.69	12.85			15.48
Blackburn	Pawnee												17.85	28.60			38.92
Chandler	Lincoln														46.41	34.03	40.22
Cloud Chief	Washita														39.11	22.03	30.57
Ft. Reno	Canadian	31.91	28.79	26.77	33.51	29.40	18.28	22.78	19 18	25 56			37.12	19 18	40.14	35.20	28.86
Ft. Sill	Comanche	29.29	31.08	32.76	34.32	24.19	24.08	29.17	17.12	26.29	37.35	46.51	36.47	16.07	46.79	18.68	30.06
Guthrie	Logan						22.99	30.69	31.71			32.62	29.83	19.33	42.19	33.42	32.11
Hennessey	Kingfisher										37.73	35.19	29.89	19.32	31.58	25.46	29.86
Jefferson	Grant						17.69	21.56	26.01	29.70	38.54		27.81		27.82		27.01
Jenkins	Woods										28.26	30.61	28.42	18.92	30.84	29.60	27.85
Kingfisher	Kingfisher										39.73	34.45	30.56	26.13	42.55	23.75	32.86
Mangum	Greer					11.39	19.52	32.89	22.85	22.49	30.91					19 81	22.67
McComb	Pottawatomie				45.84	27.75	25.10	36.17	26.08	33.47	43.20	34.86	29.91	19 12	42.76	25.20	32.41
Meeker	Lincoln						22.99	38.19	19.43	32.69	38.75			22.96	36.19	34.39	30.61
Newkirk	Kay												26.06	28.79	43.96	30.82	32.40
Norman	Cleveland							34.78	28.80	31.24			37.11	19.19			29.22
Oklahoma City	Oklahoma			37.43	42.29	24.28	26.72	32.50	21.90	28.47	35.88	43.66	31.45	15.74	41.14	27.61	31.12
Pawhuska	Osage Nation										54.24	57.96		24.54	47.24	40.69	44.92
Perry	Noble											34 43		24.04	41.11	29.48	32.27
Sac and Fox Ag'cy	Lincoln								26.95				35.17	20.80		30.88	28.19
Stillwater	Payne									31.88	42.62	32.87	29.98	19.98	40.21	32.58	32.80
Taloga	Dewey													17.33	28.87	22.49	22.73
Waukomis	Garfield										29.20	31.29	28.81	21.18	33.94	27 40	28.6

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FINANCIAL REPORT OF THE OKLAHOMA AGRICULTURAL EXPERIMENT STATION.

FOR THE YEAR ENDED JUNE 30, 1904.

Dr.

To Receipts from the Treasurer of the United States as per appropriation for fiscal year ended June 30, 1904, as per Act of Congress approved March 2, 1887, ... $15000.00

Cr.

By Salaries	1	$6337.50
Labor	2	3228.91
Publication	3	1032.83
Postage and Stationery	4	463.17
Freight and Express	5	168.65
Heat, Light and Water	6	261.32
Chemical Supplies	7	133.73
Seeds, Plants, and Sundry Supplies	8	379.48
Fertilizers	9	1.00
Feeding Stuffs	10	667.35
Library	11	79.67
Tools, Implements and Machinery	12	283.02
Furniture and Fixtures	13	31.10
Scientific Apparatus	14	95.46
Live Stock	15	570.71
Traveling Expenses	16	501.10
Contingent Expenses	17	15.00
Building and Repairs	18	750.00
Total		$15000.00

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SUPPLEMENTARY STATEMENT, 1903-1904.

Receipts and Disbursements of Station Sale Fund.

Dr.

To Balance, July 1, 1903	$1123.67
Receipts from Sale of Station Products	1475.00
Total	$2598.67

Cr.

By Labor	$ 169.31
Publications	684.00
Freight and Express	1.81
Chemical Supplies	16.40
Seeds, Plants, and Sundry Supplies	.60
Feeding Stuffs	656.92
Tools, Implements, and Machinery	6.45
Livestock	301.00
Traveling Expenses	41.15
Contingent Expenses	33.50
Building and Repairs	44.02
	$1955.16
Balance	643.51
Total	$2598.67

Disbursements of Vaccine Appropriation, General Revenue Fund.

Salaries	$1020.00
Labor	41.50
Publications	117.68
Postage and Stationery	174.00
Freight and Express	2.60
Livestock	66.00
Total	$1421.78

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PUBLICATIONS.

A few copies of each of the following publications are still on hand and will be sent in response to requests so long as the supply lasts.

No. 45, Mar. 1900—An Annotated catalogue of the ferns and flowering plants of Oklahoma.

No. 46, May 1900—Digestion trials.

No. 49, Feb. 1901—A rhizomorphic root-rot of fruit trees.

No. 51, Dec. 1901—Feeding cottonseed meal to hogs.

No. 53, June, 1902—Common parasites of domestic animals.

No. 54, June, 1902—The improvement of the castor plant.

No. 55, Dec. 1902—Bermuda grass.

No. 56, Dec. 1902—Garden vegetables.

No. 57, March, 1903—Directions for using vaccine for the prevention of blackleg in cattle.

No. 58, June, 1903—Fattening steers; using cottonseed, cottonseed meal ,wheat meal, wheat straw, and hay.

No. 59, Sep., 1903—Reprints from bulletins Nos. 47, 50, and 52, and annual reports 8 to 11.

No. 60, Dec., 1903—Planting trees for posts, fuel and windbreaks.

No. 61, Jan., 1904—Field experiments.

No. 62, May, 1904—Disinfecting power of coal tar dips.

No. 63, May, 1904—Tuberculosis in hogs.

Address all requests to

EXPERIMENT STATION,
Stillwater, Okla.

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INDEX.

A.

PAGE

Admission to college 6
Agricultural course 8, 10
Agricultural department 16
Annual precipitation 63
Arbor day 55

B.

Bermuda grass 39
Blackleg in cattle 46
Botanical department 19
Buildings needed 22
Bulletins issued 20
Business course 12

C.

Cattle mange and Texas itch 47
Cedar seed, planting 54
Checking migrating caterpillars 59
Chemical department 19
College report 5-14
Comparative yields of corn and Kafir corn 35
Continuous wheat culture 26
Corn for seed 33
Correspondence of station 22
Courses of instruction 5

D.

Delayed germination of wheat 30
Destroying Bermuda grass 40
Director's report 15-23
Domestic economy 10

E.

Engineering course 9
Expenses attending college 13

F.

Farmers' institutes 22
Feeding experiments 43
Financial statement 64
Fruit varieties 53

G.

General science course 6-7

Digitized by Google

H.

PAGE

Hessian fly 57
Hog cholera 51
Horticultural department 18

K.

Kafir yields compared with corn 35

L.

Lumpy jaw 50

M.

Mailing list 21
Manuring wheat land 26

O.

Oats crop 31

P.

Pasturing wheat 28
Ponds for stock water 40
Press bulletins 24-62
Preventing blackleg 46
Privet, disease of 61
Publications available 66

R.

Rainfall 63
Rape for forage 38
Reprints of bulletins 62

S.

School of agriculture 10
Seed selection 27, 32, 33
Short courses 11
Steer feeding experiments 41
Stock water from ponds 40

T.

Texas itch 47
Time of plowing for wheat 25
Time of seeding wheat 24
Tree planting 55

V.

Vaccinate for blackleg 46
Varieties of wheat 27
Veterinary department 15

W.

Water for stock 40
Webworm on cotton and alfalfa 59
Wheat experiments 24-31
Windbreaks 52

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